ABSTRACTS

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Sunday, July 8, 2007
SYMPOSIA

Triennial Growth Symposium: Interface Between Growth and Immunology

1 Brain-immune-periphery cross talk: Shared signals that link pathogen sensing and growth biology. J. L. Burton*, *Michigan State University*, *East Lansing*.

Animal survival depends upon the dual ability to modify metabolism according to environmental cues and mount effective immune reactions against pathogens. Both appear to rely on coordinated cross talk between the brain, immune system, and peripheral tissues such as the liver, skeletal muscle and fat. For example, recent work from our group has shown that stress hormone elaborated during brain-adrenal axis activation modifies the transcriptome of innate immune cells such that they forgo their traditional pathogen fighting behaviors in favor of higher priority metabolic activities such as tissue remodeling and repair. Other researchers have shown that myofibers and adipocytes share striking similarities with immune cells, allowing them to respond to and actively participate in pathogen sensing and local inflammatory responses but modifying their metabolic status to promote protein and fat mobilization in support of the higher priority immune reactions. This coordinated response is possible because the cells of each system express a variety of shared pathogen recognition molecules, receptors, and secreted cytokines/hormones that co-regulate inflammation and metabolism through the ability to influence activities of NF-kappaB and PPAR-gamma, key transcription factors which are also shared by the cells. As such, the brain, immune cells, skeletal muscle, and adipose tissue are both targets of and active participants in inflammation that helps clear pathogens but also modifies protein and fat accretion and thus animal growth.

Key Words: Immunity, Inflammation, Growth

2 Interleukin-15: A cytokine which modulates fat:lean body composition. L. S. Quinn*[1,2], [1]*University of Washington*, *Seattle*, [2]*VA Puget Sound Health Care System*, *Seattle, WA*.

Recent progress in understanding the hormonal control of fat:lean body composition has been made through identification of proinflammatory cytokines and other circulating factors produced by adipose tissue which affect body composition. Adipose-derived factors such as leptin, TNF-alpha, resistin, and adiponectin have been shown to affect muscle protein accretion and insulin sensitivity by direct actions. This talk reviews recent data which demonstrate the existence of a reciprocal muscle-to-fat signaling pathway involving release of the cytokine interleukin-15 (IL-15) from muscle tissue. Data are presented from transgenic mouse models, cell culture studies, short-term in vivo studies, and human genotype association studies which all support the model that muscle-derived IL-15 can decrease fat deposition and insulin sensitivity via a muscle-to-fat endocrine pathway. Fat:lean body composition is an important factor determining the efficiency of meat production, as well as the fat content of meat products. The information presented contributes to an increasing body of literature linking immune and inflammatory factors to growth and control of body composition.

Key Words: Interleukin-15, Muscle, Adipose Tissue

3 Regulation of muscle growth by pathogen associated molecules. R. A. Frost* and C. H. Lang, *The Pennsylvania State University*, *Hershey*.

Skeletal muscle demonstrates great plasticity in response to environmental and hormonal factors including pathogen-associated molecules, inflammatory cytokines and growth factors. These signals impinge on

muscle by forcing individual muscle fibers to either grow or atrophy. We have recently demonstrated that skeletal muscle cells express multiple Toll-like receptors (TLRs) that recognize bacterial cell wall components such as lipopolysaccharide (LPS). Exposure of muscle cells to LPS and other TLR ligands stimulates an inflammatory response characterized by the autocrine production of cytokines and nitric oxide (NO) by nitric oxide synthase (NOS)-2.

The TLRs signal through protein kinases that phosphorylate and promote the degradation of an inhibitory protein that normally retains the transcription factor nuclear factor kappa B (NFκB) in the cytoplasm. Phosphorylation and degradation of IκB allows for translocation of NFκB to the nucleus and activation of inflammatory genes. Overexpression of a constitutively active IκB kinase in skeletal muscle causes severe wasting and we find that inhibitors of either the phosphorylation of IκB or its proteolytic degradation prevent TLR ligand-induced expression of cytokines and NOS2.

The combination of LPS and IFNγ dramatically enhances the magnitude and duration of LPS-stimulated NOS2 expression and reduces protein translation by 80%. LPS/IFNγ also down regulates signaling from the mammalian target of rapamycin (mTOR) a kinase that directs changes in cell size. NOS inhibitors block the fall in muscle cell protein synthesis and restore translational signaling suggesting that activation of the NOS2-NO pathway is responsible for the observed decrease in muscle protein synthesis.

Our work provides a molecular explanation for reduced muscle growth during infection. Muscle is largely self-sufficient as it expresses receptors, signaling pathways, and effectors to regulate its own size. Prolonged activation of NFκB and NOS2 has emerged as detrimental facets of the immune response in muscle. The interplay between inflammatory components and growth factor signaling clearly places muscle at the interface between growth and immunity.

Key Words: Muscle, Growth, Cytokines

4 Insulin resistance by TNF-alpha in skeletal muscle and fat. M. Lorenzo*, S. Fernandez-Veledo, R. Vila-Bedmar, L. Garcia-Guerra, and I. Nieto-Vazquez, *Biochemistry Department, Pharmacy Faculty, Complutense University*, *Madrid, Spain*.

Insulin resistance, defined as the diminished ability of a cell to respond to the action of insulin, is an important contributor to the pathogenesis of type 2 diabetes. Obesity is a risk factor for development of type 2 diabetes, due in part to the fact that adipose tissue secretes proteins called adipokines that may influence glucose homeostasis and insulin sensitivity. Among these molecules, tumor necrosis factor (TNF)-alpha has been proposed as a link between obesity and insulin resistance because TNF-alpha is overexpressed in adipose tissues of obese animals and humans, and obese mice lacking either TNF-alpha or its receptors showed protection for developing insulin resistance. We have investigated how the direct exposure to TNF-alpha induces a state of insulin resistance on glucose uptake in myocytes and brown adipocytes by affecting insulin receptor substrate (IRS) proteins through activation of pro-inflammatory pathways. In this regard we identified the residue Ser 307 in IRS-1 as a site for TNF-alpha-impaired insulin-signaling in myotubes, being p38MAPK and IKB kinase involved in the phosphorylation of this residue. Conversely, serine phosphorylation of IRS-2 mediated by activation of p38- and p42/p44-MAPK by TNF-alpha was the mechanism found in brown adipocytes. Protein-tyrosine phosphatase (PTP)1B acts as a physiological negative regulator of insulin signaling by dephosphorylating the phosphotyrosine residues of the insulin receptor and IRS-1, and PTP1B expression is increased in muscle and adipose tissue of obese and diabetic humans and rodents. We have recently found that TNF-alpha up-regulated PTP1B expression. Accordingly, immortalized myocytes and primary brown adipocytes have been generated from PTP1B-deficient and wild-type neonatal mice. Cells deficient on PTP1B were protected against insulin resistance by this cytokine. In conclusion, the lack of PTP1B in muscle and adipose cells increased insulin sensitivity and glucose uptake and could confer protection against insulin resistance induced by adipokines.

Key Words: TNF-alpha, Insulin Resistance, Muscle and Fat

5 Proinflammatory changes in adipose tissue: Effects of diet-induced obesity. D. K. Brake, H. Wu, C. M. Ballantyne, and C. W. Smith*, *Baylor College of Medicine*, *Houston, TX*.

Obesity is associated with chronic inflammation, which may contribute to the high risk for type 2 diabetes, cardiovascular disease and metabolic syndrome with elevated markers of systemic inflammation. In obesity, macrophage accumulation in adipose tissue is increased, and monocyte chemoattractant protein 1 (MCP-1, CCL2) and its receptor, CC chemokine receptor-2 (CCR2), are up-regulated. Using a diet-induced mouse obesity model, we examined the expression of adhesion molecules, chemokines, inflammatory cytokines and leukocyte subsets in adipose tissue. Six week old C57BL/6J mice were fed a high fat diet (41% Kcal from milk fat) for 3, 10 and 24 weeks. After 3 weeks, CD54, IL-6 (but not TNF) and CCL2 were expressed in adipose tissue; two populations of CD11b+, CD54+ macrophages significantly increased in the stromal-vascular fraction of adipose, one of which also expressed CD11c and CD14. These changes were seen in male but not female mice. After 10 weeks on the diet, CD54 and IL-6 were further increased in adipose, and TNF expression was detected. The CD11c+ macrophages were still evident and increases in CD3+ cells (T lymphocytes) were evident. In addition to CCL2, CCL5 (RANTES) expression was detected. After 24 weeks, serum levels of soluble CD54 were elevated and positively correlated with fat mass in both male and female mice, though expression was significantly greater in males. CCL5, CCR5 and CD3+ cells were significantly elevated in obese male but not obese female mice. CCL5 mRNA levels were negatively correlated with adiponectin in adipose tissue, but positively correlated with CD3+ and CD11b+ cells. These observations reveal a progressive increase in proinflammatory changes in adipose tissue in dietary obesity that is pronounced in male mice, but minimal in female mice over a 24 week feeding period.

Key Words: Adipose, Inflammation, Mice

6 Critical control points in the impact of proinflammatory immune response on growth and metabolism. T. H. Elsasser*[1], S. Kahl[2], and J. L. Sartin[2], [1]*USDA-ARS-Growth Bio Lab*, *Beltsville, MD*, [2]*Auburn University*, *Auburn, AL*.

Growth is dependant on the assimilation of nutrient precursors into the structured components of all tissues. Where in the larger context of species survival, the growth and maturation of young animals into the adult constitutes the processes necessary to reproduce, nurture, and protect following generations. In production situations where we have assumed oversight of many of these life processes for the animals we raise, we have come to define growth largely in terms of production criteria. Intrinsic in the equation for successful animal production is the efficiency of nutrient use for assimilation into useful animal-derived product. However, in many management scenarios there develop time periods during which animals will experience levels of proinflammatory response (PR) as mediated through components of the immune system. The efficiency of nutrient use will proportionally decrease for growth rate at the expense of the redirection of nutrient use to support immune response tissues and processes. These PR events can develop in association with infectious disease and infestation but also are a part of the response to vaccination and the natural and management processes of birth, parturition, and weaning. If growth patterns are tracked during these periods of PR, growth deficits are often apparent, some relatively transient in duration and others quite long lasting, persisten though traditional clinical markers of PR are no longer evident. Recent evidence suggests that the PR cascades initiated by cytokines like tumor necrosis factor-α play a major role in these growth deficits in concert with the functions of Toll-like- and CD14 receptors, NF-κB proteins, nitric oxide synthase isoforms and superoxide anion generation; where the cascade tends to over-respond, the generation of free radicals and reactive nitrogen intermediates causes the nitration and nitrosylation of select amino acids in many metabolic regulatory and signal transduction proteins altering their functionality. The potential for dietary strategies to moderate PR-affected perturbations in growth are discussed.

Key Words: Proinflammatory Response, Growth, Metabolism

7 Bi-directional communication: Growth and immunity in domestic animals. J. A. Carroll*, *USDA-ARS Livestock Issues Research Unit*, *Lubbock, TX*.

Evidence continues to mount supporting the existence of bi-directional communication pathways between the animal's growth axis and immune system. For more than three decades, researchers have sought, and identified, linkages between the somatotrophic axis and health in domestic livestock. Early investigations were particularly interested in the various effects of exogenous growth hormone (GH) on both *in vitro* and *in vivo* aspects of immunity in domestic livestock. During an immunological insult, an uncoupling of the GH/insulin-like growth factor I (IGF-I) axis occurs resulting in elevated concentrations of GH in the presence of low circulating concentrations of IGF-I. Typically, sick animals experience a period of anorexia, thus requiring nutrient repartitioning and nutrient sparing to liberate nutrients for the production of proteins such as the pro-inflammatory cytokines and acute phase proteins that are critical for re-establishing homeostasis. While the energy liberating effects of GH are well-recognized, the significance of elevated GH during times of sickness-induced anorexia may be more profound due to its stimulatory actions on immune cells. In addition to GH, IGF-I and its associated binding proteins (IGFBP) have also generated significant interest with regard to their interactions with various pro-inflammatory cytokines and the overall effect on muscle growth and repair. For example, recent studies have demonstrated that the pro-inflammatory cytokines interleukin 1-beta (IL-1β) and IL-6 can impair IGF-I stimulated muscle growth, and may alter IGFBP profiles thereby indirectly altering the bioactivity of IGF-I (Broussard et al., 2004). In contrast to the catabolic actions of IL-1 β and IL-6 on muscle tissue, IL-15, a cytokine produced in various tissues including placenta, skeletal muscle, kidney, lung, heart, and macrophages, has been reported to act in an additive fashion with IGF-I on muscle fiber growth (Quinn et al., 1995). Further elucidation of the cross-communication that takes place among the endocrine, neuroendocrine, immune, and nutritional processes within the body will undoubtedly continue to be unveiled as researchers pursue the complexities associated with the regulation of the immune system.

Key Words: Growth, Immune Function, Cytokines

Monday, July 9, 2007
POSTER PRESENTATIONS

Animal Behavior & Well-Being - Livestock and Poultry I

M1 Analysis of the association of parity, body condition and lactation feed intake with claw lesions in breeding sows. S. S. Anil*, L. Anil, and J. Deen, *University of Minnesota*, *St Paul*.

Severe claw lesions can cause lameness in pigs. It is important to identify and analyze the association between claw lesions and various risk factors in order to minimize the incidence of such lesions to reduce removal of sows for lameness. The objective of this study was to analyze the association of factors such as parity, body condition (BC) score and average lactation feed intake (LFI) with lesion scores (< median vs. ≥ median) on different claw areas in breeding sows using separate univariate logistic regression models (Proc logistic, SAS V 9.1). Claws of 771 sows in a breeding herd in Minnesota were examined for lesions on day 110 of gestation. Areas on the claw were classified as side wall (SW), heel (H), overgrown heel (OGH), sole (S), heel-sole junction (HSJ), white line (WL) and toe (T). Lesions were scored on a scale of 0 (no lesions) to 4 (severe). The final score on each area was obtained by multiplying the number of lesions by the severity of these lesions. Data on the parity of the sow and LFI were collected from the sow cards and BC was scored visually on a 5 point scale. For analysis, parity was categorized as parities 1 and 2, 3-5 and ≥ 6. The BC scores were categorized as ≤ 2 and ≥ 3. Average LFI was included in the model as a continuous variable. Sows of parity 1 and 2 had a higher likelihood of ≥ median scores for WL and HSJ lesions than sows of parity ≥ 6 (Odds ratio, OR 4.34 and 1.94 respectively) and lower likelihood of ≥ median scores for H lesions and OGH (OR 0.56 and 0.58 respectively, P ≤ 0.05 for all). Sows of parity 3-5 had lower (P ≤ 0.05) likelihood of ≥ median scores for OGH (OR 0.60) and higher (P ≤ 0.05) likelihood of ≥ median scores for WL lesions (OR 2.23) and HSJ lesions (OR 1.57). The odds of having ≥ median lesion scores were 58% and 43% higher (P ≤ 0.05) for sows with BC score of ≤ 2 compared to sows with a condition score of ≥ 3 on SW and WL respectively. The likelihood of ≥ median H lesion scores increased (P ≤ 0.05) by approximately 50% with every kg increase in average LFI. Results indicated that claw lesions were associated with parity, body condition and lactation feed intake.

Key Words: Claw Lesions, Sows

M2 Analysis of the association of claw lesions with lameness in breeding sows. L. Anil*, S. S. Anil, and J. Deen, *University of Minnesota*, *St Paul*.

Claw lesions are very common in pigs. Severe claw lesions can cause lameness, a welfare concern, and a major reason for early removal of sows from breeding herds. Housing conditions and management practices may be associated with the development of claw lesions. It is important to understand the association between claw lesions and lameness in order to minimize the incidence of such lesions and to reduce removal of sows for lameness. The objective of this study was to analyze the association of different types of claw lesions with lameness. Claws of 771 sows in a commercial breeding herd in Minnesota were individually examined for lesions on day 110 of gestation when sows were in the farrowing stalls. Lesions included erosions, cracks, and overgrowths. Areas on the claw were classified as side wall, heel, overgrown heel, sole, heel-sole junction, white line and toe. Lesions were scored on a scale of 0 (no lesions) to 4 (severe). The final score on each area was obtained by multiplying the number of lesions by the severity of these lesions. A multivariate logistic regression analysis was performed (Proc logistic) to assess the association of lesion scores (less than median vs. ≥ median) on different claw areas with lameness (lame vs. non-lame). The lesion scores on different claw areas of lame and non-lame sows were compared using Kruskal-Wallis test. Lesions on the heel and the white line were associated with lameness whereas overgrown heel, lesions at heel-sole junction and sole lesions were not associated with lameness. Sows with less than median heel lesion scores had 34% lower (P ≤ 0.05) likelihood of being lame. Similarly, sows with less than median white line lesion scores were less (P ≤ 0.05) likely to be lame (Odds ratio 0.689). Sows with less severe side wall lesions were less likely (Odds ratio 0.686) to be lame (P = 0.06). The comparison of lesion scores indicated higher (P ≤ 0.05) scores on side wall and white line in lame sows. Though not significant (P = 0.06), sole lesion scores tended to be higher in lame sows.

Key Words: Lameness, Sow, Claw Lesions

M3 Analysis of the association of periparturient risk factors with sow longevity. L. Anil*, S. S Anil, and J. Deen, *University of Minnesota*, *St Paul*.

Premature removal of sows in breeding herds is a reason for both economic and welfare concerns. Removal of younger parity females means that they are removed before they attain peak production performance. Farrowing is a high risk event in the life of a breeding female. The objective of the present study was to analyze the association of factors including parity, number of piglets born alive, lactation length, lactation feed intake and incidence of lameness during periparturient period (including lactation) with likelihood of sow

removal (cull, death or euthanasia) within 35 days post farrowing or before the next farrowing using multivariate logistic regression models (Proc logistic, SAS v 9.1). Data were (n =1357) collected from a commercial herd in Minnesota. Risk factors found significant ($P \leq 0.05$) in the univariate analyses were only included in the multivariate model. For analysis, lameness was categorized as lame or non-lame and parity as parities 1 and 2, 3-5 and ≥ 6. Other variables were included in the model as continuous variables. The results indicated that the likelihood of removal from the herd within 35 days post-farrowing decreased ($P \leq 0.05$) by approximately 19% with every additional piglet born alive. The risk of removal from the herd before 35 d post-farrowing decreased ($P \leq 0.05$) by 34 % with every additional kg increase in average lactation feed intake. Sows that did not have lameness during periparturient period had a lower ($P \leq 0.05$) likelihood of removal from the herd before 35 d post-farrowing (Odds ratio 0.260) compared to the other sows. Sows of parity 1 and 2, and 3 to 5 had lower ($P \leq 0.05$) likelihoods of removal from the herd before 35 d post-farrowing compared to sows of parity ≥ 6 (Odds ratios 0.181 and 0.285 respectively). Number of piglets born alive (Odds ratio 0.916), incidence of lameness (Odds ratio 0.626) and parity (Odds ratio 0.548 and 0.558 respectively for parities 1 and 2 and parities 3-5 respectively) appeared to influence the likelihood of removal of sows from the herd before next parity as well ($P \leq 0.05$ for all).

Key Words: Longevity, Sows, Periparturient Risk Factors

M4 Stress level of steers in long distance transport in Japanese four seasons. T. Ishiwata*, K. Uetake, Y. Eguchi, and T. Tanaka, *Azabu University*, *Sagamihara, Kanagawa, Japan*.

The objectives of this study were to investigate transportation conditions and behavioral and physiological responses of beef steers in long distance commercial transport in Japan. Japanese black × Holstein steers aged 8 mo were transported by truck in spring (n = 8), summer (n = 5), autumn (n = 8) and winter (n = 5). Transport distances (time) were 1,020.6 km (25 h including lairage periods): 615.4 km (6.4 h) on expressways, 163.2 km (3.7 h) on arterial roads and 242.0 km (10.5 h) by ferry. Internal temperatures of the truck were 14.7 ± 4.7°C in spring, 27.9 ± 2.6°C in summer, 24.4 ± 2.8°C in autumn and 9.2 ± 4.3°C in winter. During transport, more steers were lying during moving on expressways (chi square test, $P < 0.001$). The reason for this should be that vibration acceleration (m/s^2) of the truck in the lateral direction was smaller on the expressways (0.29 ± 0.36) than on arterial roads (0.31 ± 0.16) (Tukey's studentized range test, $P < 0.05$). Blood glucose, plasma cortisol, serum triiodothyronine (T_3) and ALT (reflecting liver function) concentrations were higher in spring (Tukey's studentized range test, all $P < 0.05$). This could be explained by that vibration acceleration (m/s^2) of the truck in the longitudinal direction was bigger in spring (-0.19 ± 0.43) than in the other seasons (-0.14 ± 0.09 in summer, -0.15 ± 0.20 in autumn and -0.15 ± 0.13 in winter) (Tukey's studentized range test, all $P < 0.01$). Furthermore, internal airflow velocity (m/s) of the truck was lower in spring (0.75 ± 0.70) than in summer (1.72 ± 1.88) and winter (1.31 ± 1.33) (Tukey's studentized range test, both $P < 0.01$). Heart rate, serum concentrations of T_3 , cholesterol, protein, AST (reflecting liver function) and ALT were higher just after transport than 1 wk after transport (Tukey's studentized range test, all $P < 0.05$). However, level of transport stress should be low, since no difference between before and after transport was shown on concentrations of plasma cortisol, blood lactate and serum NEFA, and serum pH and BW.

Key Words: Beef Cattle, Transport, Stress

M5 Welfare assessment of cattle transported in Japan. K. Uetake*, T. Ishiwata, Y. Eguchi, and T. Tanaka, *Azabu University*, *Sagamihara, Kanagawa, Japan*.

The objective of this study was to assess cattle welfare during transportation. Vehicle inspection and observation of cattle behavior were conducted at major livestock markets (T and M) in Japan. Market T provided young cattle (Wagyu and crossbred aged 6.8 to 9.0 mo) mainly for regions farther than 1,500 km. Market M provided young cattle (Wagyu aged 6.6 to 11.2 mo) and small calves (crossbred and Holstein aged 21 to 47 d) for nearby regions less than 500 km. Market T had loading platforms 1.0 m high, whereas market M did not have them and forced transporters to load cattle from the ground. Requirements to be met by vehicles were inspected according to the welfare standards for beef cattle of the RSPCA. Number of vehicles inspected was 36 and 31 in markets T and M, respectively. Cattle hesitations (kneeling down, slipping, balking, backing down, turning around, jumping and eliminating) were observed at the loading ramp. Vehicles inspected at the markets complied with most requirements of the welfare standards, but non-compliance was found in two requirements: In market M, 71.0% of vehicles had the loading ramp at more than a 20% incline, whereas 17.1% of vehicles did in market T (chi square test, $P < 0.001$). Slope of the loading ramp was steeper in market M than in market T (median 35.9% vs. 14.5%; Mann-Whitney test, $P < 0.001$). Market M had higher proportion of vehicles that did not comply with the requirement 'Both loading ramps and tail boards must be appropriately designed and covered with litter, to prevent animals from falling off or slipping' compared with market T (83.9% vs. 17.1%; chi square test, $P < 0.001$). Higher frequencies were observed in some hesitations in market M than in market T (Mann-Whitney test, all $P < 0.05$): Median frequencies (times/head) of slipping, balking and jumping were 1.0, 1.1 and 0.1 in market M, and 0.0, 0.8 and 0.0 in market T, respectively. Steeper loading ramp was correlated with higher frequencies of kneeling down ($r = 0.53$), slipping ($r = 0.59$), balking ($r = 0.45$) and backing down ($r = 0.42$) in market M (Pearson's correlation coefficient, all $P < 0.05$).

Key Words: Beef Cattle, Transportation, Welfare

M6 Spirit of humane. J. M. Regenstein*[1], J. Moses[2], and L. Jacoby[2], [1]*Cornell University*, *Ithaca, NY*, [2]*Shepherd Song Farms*, *Downing, WI.*

The recent emphasis in the US and Europe on animal welfare often presents a challenge for small meat processors and on-farm slaughter operations (where permitted by law) to meet modern animal welfare slaughter standards such as those of the Food Marketing Institute and the National Council of Chain Restaurants. This can especially be the case for the special slaughter needs of the religious communities, particularly the Muslim community, where all adult Muslim ideally slaughter a sheep or goat at least once a year. It may also be a challenge for small scale slaughter in the Jewish community, where only a trained slaughterman is used. Other ethnic groups wanting freshly slaughtered meat may not be knowledgeable about current animal welfare standards. As one looks at the developing world, there is an even greater need to educate people about animal welfare, ideally presenting them with a workable solution. Working with Dr. Temple Grandin (Colorado State Univ.), a small scale, low-cost sheep/goat slaughter pen has been designed that builds on her double rail animal support system. An appropriate commercially available slaughter knife with a long straight blade has been identified that is ideal for religious

slaughter and for the slaughter of un-stunned animals, giving an easily handled, calm animal. This assures that the full humane benefits of un-stunned slaughter can be realized. In addition an educational poster on humane animal handling has been prepared for both religious and non-religious slaughter and this poster has been translated into a number of other languages including: Arabic, Malay, Persian, Spanish, Somali, Turkish and Urdu. The original pen design for sheep and goats has been modified to make it efficiently shippable and easily assembled without any special tool requirements. An alternate pen for larger animals is being designed with the same criteria, but obviously requiring a sturdier structural framework.

Key Words: Humane Slaughter, Sheep, Goats

M7 Comparison of beak trimming methods on early broiler breeder performance. S. N. Henderson*[1], J. T. Barton[2], W. J. Kuenzel[1], A. D. Wolfenden[1], S. E. Higgins[1], J. P. Higgins[1], C. A. Lester[1], G. I. Tellez[1], and B. M. Hargis[1], [1]*University of Arkansas*, *Fayetteville*, [2]*Tyson Foods*, *Springdale, AR*.

Beak trimming is necessary in commercial broiler breeders to prevent aggressive trauma as they mature. Two common methods were evaluated by early performance comparison with non-trimmed chicks (NBT). The robotic electrocautery device (ECD) trims and cauterizes the beak tip, while the robotic infrared beak trimming device (IBT) applies an infrared light beam to destroy the live basal tissue while leaving the hard corneum intact for the first ~10 days. On day-of-hatch, 900 Ross 708 byproduct chicks were obtained from a local hatchery, and 1/3 of the chicks were trimmed using IBT. All 900 chicks were then transported to another hatchery where 1/3 were trimmed using ECD. Personnel at each hatchery were highly experienced and skilled with their respective technique. All chicks were then transported to UA facilities where chicks were co-mingled, provided ample feeder and water space, and age-appropriate environment on fresh wood shavings. Prior to placement, chicks were individually neck tagged, weighed, and beaks were measured using a digital caliper: from the rostral point of the nares to either the beak tip (NBT and IBT) or amputated line (ECD). Initial beak measurements of NBT group (6.3 mm) were significantly ($p<0.05$) longer than ECD (3.8 mm) and the intact beak of IBT (5.8 mm). No significant ($p>0.05$) differences in body weight gain (BWG) were observed among treatments at 4 d (NBT: 35.5g; ECD: 32.3g; IBT: 32.7g) or 7d (NBT: 81.2g; ECD: 81.2g; IBT: 82.9g) post-placement. Effects of treatments on BWG through 6 wks will be reported. These results suggest that when beak trimming is performed on day-of-hatch by skilled and experienced personnel, little measurable effects on performance are observed during this critical first 7 day period when ample feeder and water space are provided.

Key Words: Beak Trimming, Early Performance

M8 Analysis of the incidence of claw lesions in breeding sows. S. S. Anil*, L. Anil, and J. Deen, *University of Minnesota*, *St Paul*.

A painful lesion in the claw can cause lameness in pigs. Housing conditions and management practices may be associated with development of claw lesions. Measures to minimize the incidence of claw lesions and lameness must be preceded by attempts to understand the pattern of the incidence of claw lesions. The objective of this study was to characterize claw lesions in breeding sows. Claws of 771 sows in a commercial breeding herd in Minnesota were individually examined for lesions on day 110 of gestation when sows were in the farrowing stalls. Lesions included erosions, cracks, and overgrowths. Areas on the claw were classified as side wall (SW), heel (H), sole (S), heel-sole junction (HSJ), white line (WL) and toe (T). Lesions were scored on a scale of 0 (no lesions) to 4 (severe). The final score on each area was obtained by multiplying the number of lesions by the severity of these lesions. The proportions of sows with and without lesions on different areas in the lateral and medial claws of front and hind limbs and the proportions with severe (≥ 4 score) and less severe (≤ 3 lesion score) were compared using 1-sample and 2 sample proportion tests. The proportions of sows with overgrown heel (OGH), and lesions on SW, H and WL were higher than the proportions without lesions ($P \leq 0.05$, 1- sample proportion test). However, a higher ($P \leq 0.05$) proportion of sows had no lesions on the T. There was no difference in the proportion of sows with and without lesions on the S and HSJ. A higher proportion of sows had lesions on the SW, WL, HSJ, S and T in the front limbs compared to the hind limbs ($P \leq 0.05$, 2-sample proportion test). A higher proportion of sows had H lesions and OGH in the hind limbs than in the front limbs ($P \leq 0.05$). In both front and hind limbs, the proportions of sows with lateral claw lesions were higher than those with medial claw lesions ($P \leq 0.05$, 2-sample proportion test). The proportions of sows with ≤ 3 lesion scores in all claw areas except the SW were higher ($P \leq 0.05$, 1-sample proportion test) than the proportions with ≥ 4 lesion scores. The study indicates a high prevalence of claw lesions, especially severe SW lesions.

Key Words: Claw Lesions, Sows

M9 Effect of the presence of hungry conspecifics in the stress and weight gains of recently weaned lambs. J. Rojas, R. Vázquez, F. I. Flores-Pérez, V. Aguirre, and A. Orihuela*, *Universidad Autónoma del Estado de Morelos*, *Morelos, México*.

Newly-weaned lambs were exposed to feed in the presence of hungry conspecifics to determine if socially-facilitated feeding behavior would help to alleviate stress and improve weight gains during the period immediately following weaning. Twenty-two (Dorper X Santa Cruz) single lambs, were assigned to two groups at 60 days of age. No lambs were added to the control group, while in the experimental group, a total of fifteen hungry weaned lambs were added daily with a 90 min interval between introduction of each group of five hungry lambs starting at the time of mother young separation (08:00). These hungry lambs were fasted for 12 h previous to their use. Significant ($P<0.05$) increases in the number of visits to the feeders and serum cortisol concentration were observed daily during four days in the experimental lambs in comparison with the controls. Lambs in the experimental group vocalized less ($P<0.05$) frequently than controls during the third and fourth day of separation, while no differences ($P>0.05$) were found between groups or days in the number of animals lying and individual weight gains. It was assumed that the increased number of visits to the feeder by the experimental lambs was a socially facilitated behavior in response to the continuous use of the feeders achieved by the hungry lambs. As a consequence of this increase in locomotor activities, fewer experimental animals were observed lying. In addition, the reduction in vocalizations in the experimental group on days three and four may reflect a reduction in separation distress or habituation to the test procedure. The higher cortisol concentrations of the experimental group may have been induced by the constant changes in social

environment and handling that the experimental group experienced. It was concluded that social facilitation increased the number of visits to the feeders, but had no effect on the stress and weight gain of recently weaned lambs.

Key Words: Welfare, Weaning, Lambs

M10 Bone quality, behavioural repertoire, and physical condition of laying hens housed in conventional, modified and furnished colony battery cages. M. J. Jendral*[1], D. R. Korver[1], J. S. Church[2], and J. R. Feddes[1], [1]*University of Alberta*, *Edmonton, Canada*, [2]*Alberta Agriculture, Food and Rural Development*, *Edmonton, Canada*.

The welfare of White Leghorn hens housed in conventional (CON) (30cm x 45cm) (n=84), modified (MOD) (n=84) (60cm x 45cm) and furnished colony (120cm x 110cm) (n=24) cages was investigated by evaluating bone quality, behavior and physical condition. All cages provided 450cm^2 floor space/hen. CON and MOD each housed 3 hens, and MOD contained a perch (30cm x 5cm) and nestbox (NB) (24cm x 45cm), providing an additional 360cm^2 of nest area/bird. Colony units, which housed 26 hens, contained a perch (120cm x 5cm), NB (60cm x 55cm) and were furnished with (CWDB) or without (CWODB) a dustbath (DB) (60cm x 20cm), providing each hen with 126cm^2 NB space, and in CWDB, 46cm^2 DB area. Video recordings at 35 and 60 wks were examined for locomotory behavior, and hen physical condition was scored at 31 and 65 wks. At 65 wks, hens were euthanized and right femur, tibia and humerus were excised for analysis. Data were analyzed using GLM for mixed effects, and scored condition values were compared by chi-square analysis. Effects were significant at $P<0.05$. CON hens exhibited lower femoral and tibial total mineral density and mass, cortical area and mass, and breaking strength than CWDB, CWODB or MOD hens, but higher density and cross sectional area of bone in the trabecular space. Total and cortical humeral density, mass and breaking strength were higher in CWDB and CWODB than in CON and MOD. Birds in CON cages exhibited more pacing, standing and escape behaviors, but fewer bouts of walking, wing flapping, stretching and ruffling than hens in furnished cages. CWDB and CWODB hens perched, jumped and walked more than hens in MOD. Average and total feather condition scores were higher for MOD and CON hens, as were the proportion of hens with higher scores for individual body regions, and head and vent wounds. Foot and claw condition were improved in furnished cages, and keel bone scores were lowest for MOD hens. These finding suggest that while group size impacts hen welfare, MOD and colony cages provide amenities that encourage movement, performance of natural behaviours and improved bone condition.

Key Words: Layer, Welfare, Behaviour and Condition

Animal Health - Livestock and Poultry: Bovine I

M11 Osteopontin expression during the periparturient period in dairy cows naturally infected with *Mycobacterium avium* subsp. *paratuberculosis* infection. E. L. Karcher*[1], D. C. Beitz[1], and J. R. Stabel[2], [1]*Iowa State University*, *Ames*, [2]*USDA-ARS-National Animal Disease Center*, *Ames, IA*.

Investigation of the role of osteopontin (Opn) in Johne's disease is of interest based upon its ability to influence cytokine expression and to improve host defense against mycobacterial infections. The objective of this study was to characterize Opn expression and secretion by peripheral blood mononuclear cells (PBMCs) isolated from periparturient dairy cows naturally infected with Mycobacterium avium subsp. paratuberculosis (MAP). Twenty-five multiparous Holstein cows were assigned to 3 groups based upon their infection status: 1) noninfected healthy cows (n = 8), subclinically infected cows (n = 10), and clinically infected cows (n = 7). Blood was collected from the jugular vein from 3 wks pre- through 5 wks post-calving. PBMCs were isolated from the buffy coat fractions of whole blood. PBMC were cultured for 24 h with and without MAP whole cell sonicate (MPS). RNA was extracted from cells, and converted to first-strand cDNA. Real-time PCR was performed on each sample to evaluate the expression of Opn. RT-PCR data was evaluated using $2^{-(\Delta\Delta Ct)}$ with samples calibrated within treatment to mean ΔΔCt value at one day after calving. Immunoblot analysis was performed for detection of Opn protein from cultured PBMCs. PBMCs isolated from subclinical cows expressed greater amounts of Opn mRNA compared with control ($P<0.06$) and clinical ($P<0.05$) cows. Expression was higher prepartum, followed by a decline at calving that was consistent until 21 days postpartum. MPS-stimulated PBMCs from subclinical cows expressed less Opn mRNA than control and clinical cows ($P<0.05$). There was no effect of parturition on expression from stimulated cells, regardless of treatment group. Immunoblot analysis of Opn detected a predominant band at 50 kDa and three minor bands at 62, 37, and 24 kDa. The data indicate an ability of MAP infection and parturition to modulate Opn expression.

Key Words: Periparturient, Osteopontin, *Mycobacterium avium* subsp. *paratuberculosis*

M12 Development of a novel enzyme-linked immunosorbent assay for the diagnosis of Johne's disease. S. Eda*[1], A. J. Branscum[2], Y. Kaneko[1], M. C. Scott[1], and C. A. Speer[1], [1]*University of Tennessee*, *Knoxville*, [2]*University of Kentucky*, *Lexington*.

Johne's disease (JD), caused by *Mycobacterium avium* subsp. *paratuberculosis* (MAP), has a significant economic impact on the US dairy cattle industry. Use of enzyme-linked immunosorbent assays (ELISA) to identify cattle for further fecal culture testing or for culling is listed as a recommended method for JD control in dairy and beef herds. However, several recent reports estimated diagnostic sensitivities of currently available ELISAs to be only 13.5 to 27.8%. For example, by using a Bayesian non-gold standard analysis, the diagnostic sensitivities of two current ELISAs were estimated to be 26-27%. Recently, it was predicted that if the diagnostic sensitivity of currently available ELISAs could be improved to 80%, then their use could result in an effective reduction of JD prevalence, higher level of milk production, and higher annual net revenue per cow. We developed a novel ELISA, called EVELISA, for the detection of MAP infections in cattle and is highly sensitive identifying 97.4% of fecal-culture positive cattle compared to a currently marketed ELISA that identified 50%. However, when 37 serum samples from a herd with a high rate of false-positives were tested by the EVELISA as well as a currently available ELISA, both ELISAs found more than 70% of the samples to be positive for JD. The false-positive rate of the

EVELISA was reduced significantly to 26.1% when the serum samples were pre-absorbed with *M. phlei*. By using the fecal culture method as the gold standard, empirical diagnostic sensitivity of the EVELISA using *M. phlei* absorption (absorbed EVELISA) was 97.1%, whereas that of a current ELISA was 48.5%. Moreover, a Bayesian non-gold standard analysis revealed that the absorbed EVELISA had a significantly higher level of diagnostic sensitivity (82%) than that of a current ELISA (22%). These data indicate that this novel ELISA is a rapid, inexpensive, specific, and highly sensitive test for JD which may improve the effectiveness of JD control measures.

Key Words: *Mycobacterium avium* subsp. *paratuberculosis*, Johne's disease, Enzyme-linked Immunosorbent Assay

M13 Effect of pasteurization on bacterial count and immunoglobulin G levels of bovine colostrum. J. A. Elizondo Salazar*, S. C. Donaldson, B. M. Jayarao, and A. J. Heinrichs, *The Pennsylvania State University*, *University Park*.

On-farm pasteurization of colostrum has received considerable attention in recent years, primarily to reduce bacterial pathogens present in colostrum. Application of this practice has been reported to result in significant health benefits for calves and economic returns for producers, however little information is available on the effect of pasteurization on immunoglobulin G (IgG) concentration. A study was conducted to determine the effect of low-temperature long-time pasteurization on the bacteriology and IgG levels in colostrum. First milking colostrum was collected from 28 primiparous and multiparous Holstein cows. Each sample was thoroughly mixed and two 10mL aliquots were analyzed. The first aliquot served as the control while the second aliquot was heated for 30 min at 62.8°C. The treated and untreated colostrum samples were examined for standard plate count (SPC), preliminary incubation count (PIC), coagulase-negative staphylococci (CNS) count, environmental streptococci (ES) count, coliform (CC) count, gram-negative noncoliform (NC) count, Streptococcus agalactiae (SAG) count, and Staphylococcus aureus (SA) count. IgG1 and IgG2 levels were measured using radial immunodiffusion. The results of the study showed that pasteurization resulted in a significant reduction of SPC, CC, NC, ES, CNS, SA, and PIC. Pasteurization also resulted in denaturation of 24% of colostral total IgG. The preliminary findings of the study suggest that gram-negative bacterial numbers (CC, NC) and gram-positive mastitis pathogens such as SA, CNS, and ES are considerably reduced.

Table 1. Bacterial count and immunoglobulin G levels of bovine colostrum before and after pasteurization.

	Unpasteurized	Pasteurized	SEM	*P*
Bacterial Count, cfu/ml				
SPC	16,161.4	21.4	4084.0	0.001
PIC	11,317.9	12.9	2985.9	0.001
CC	10,293.6	3.6	3749.6	0.001
NC	2,162.1	0.0	629.9	0.001
ES	3,784.3	0.0	2520.9	0.001
CNS	43,113.6	2.9	22724.4	0.001
SA	3,627.1	0.0	2,524.7	0.022
Immunoglobulin, mg/ml				
IgG_1	84.8	73.8	2.7	0.009
IgG_2	4.3	2.9	0.4	0.014
Total IgG	89.1	76.7	2.8	0.005

Key Words: Colostrum, Pasteurization, Immunoglobulin G

M14 Measuring bovine colostrum specific gravity using two hydrometers at various temperatures. A. J. Heinrichs*, S. A. Belegundu, C. M. Jones, and J. A. Elizondo Salazar, *The Pennsylvania State University*, *University Park*.

An indirect measure of colostrum IgG quantity has been to measure specific gravity of colostrum and apply the data to a predetermined equation. This method has been used to some degree on farms for the past 25 years, utilizing a glass hydrometer with a specific calibration chart for colostrum at 22°C. While it is known that the relationship between specific gravity and IgG is variable, this method remains one of the few rapid, on-farm means to evaluate colostrum quality. Two different hydrometers were studied in this experiment, one a standard glass hydrometer fitted with the colostrum IgG calibration chart, the other a plastic hydrometer with a similar specific gravity range. Holstein colostrum samples (n = 146) were analyzed at 15.6, 21.1 and 26.7°C to determine correlations between the 2 hydrometers over a temperature range that is frequently observed when samples are tested on-farm. Specific gravity measurements for the glass hydrometer were calculated from IgG values recorded from the instrument's scale. The correlation for specific gravity between glass and plastic hydrometers was 0.96 over all temperatures and was 0.94, 0.97 and 0.98 at 15.6, 21.1 and 26.7°C, respectively. Specific gravity was different between 15.6 and 26.7°C for both glass and plastic hydrometers. This study shows that a plastic hydrometer can be equally effective in estimating colostrum specific gravity as a glass instrument, making it a viable option for on-farm use. The potential for improved durability of this tool may encourage expanded use of the hydrometer to estimate colostrum IgG content and thus improve passive transfer in calves.

Key Words: Colostrum, Specific Gravity, Immunoglobulin G

M15 Changes in protein expression in *Escherichia coli* as a consequence of growth in milk whey. J. D. Lippolis* and T. A. Reinhards, *National Animal Disease Center / ARS/ USDA*, *Ames, IA*.

Understanding changes in protein expression by bacteria as they adapt to their environment and the pressures exerted by the host immune system to eliminate the bacteria will become a foundation to research into better therapeutics for treatment of bacterial infections. Shotgun Proteomics, using amine-reactive isobaric tags (iTRAQ) was used to quantify protein changes in Escherichia coli (mastitis isolate) grown in either Luria-Bertoni broth or milk whey. Changes in expression for over 264 proteins were obtained, 74 proteins that were down-regulated when the bacteria were grown in whey, 66 that were up-regulated and the rest were unchanged. Several proteins of immediate interest were those involve in iron transport. Iron(III) dicitrate transport protein (FECA) and Iron(III) dicitrate-binding periplasmic protein (FECB) were both up-regulated in E. coli when grown in whey by approximately 3.0 fold. An innate mechanism to limit bacterial growth is the sequestration of free iron by proteins such a lactoferrin. Therefore, necessary for successful growth in milk, bacteria must increase expression of proteins that bind and internalize iron. Our proteomic profiling suggests E. coli responded to the milk environment by increasing its own iron-binding proteins. Two proteins associated with osmotic regulation were also up-regulated when the E. coli was grown in whey. Osmotically-induced protein Y (OSMY) and Osmotically-inducible lipoprotein E (OSME) were up-regulated 4 and 5 fold respectively. There is evidence that osmotic regulation plays an important role in bacterial virulence by either affecting expression

of virulence genes or affecting bacterial growth in vivo. These data demonstrate that quantitative shotgun proteomics has great potential to provide new insights into how bacteria thrive in milk and may provide new insights into antibiotic therapies.

Key Words: Mastitis, Proteomics, Infection

M16 Results of milk samples submitted for *Mycoplasma* spp examination from California dairies between 1999 and 2005. D. F. Resende*, R. G. S. Bruno, P. V. Rossito, K. Glenn, and J. S. Cullor, *University of California*, *Davis*.

The objective of this study was to study the prevalence of *Mycoplasma* spp in California, utilizing data from milk samples submitted to the Milk Quality laboratory located at the Veterinary Medicine Teaching and Research Center (VMTRC - UC Davis) in Tulare - CA with the majority of milk samples representing San Joaquin Valley. A total of 350,412 records of microbiological testing of individual animal milk samples (n=267,357) and bulk tank milk samples (n=83,055) submitted for screening of *Mycoplasma* spp between 1999 and 2005, including milk samples obtained from mastitis cases, routine herd checks and routine creameries samples, were reviewed. Bulk milk samples represent approximately 1100 dairies, and individual cow samples represent approximately 120 dairies. Samples were cultured on Mycoplasma agar plates (UC Davis media lab) and results were recorded as no growth, contaminated and positive. In a subset of samples Fluorescent Antibody Staining was performed for *Mycoplasma*spp identification. All data was analyzed using Minitab software (Minitab 14). 9,167 bulk tank milk samples, 6,405 individual cow samples and about 40% of the dairies tested positive for *Mycoplasma* spp. *Mycoplasma* spp prevalence in bulk milk tank samples was higher in 1999 (P<0.005) when compared to the other years (2000-2005), and prevalence in individual cow samples was higher in 2001(P<0.01). There was no difference among the other years (P<0.005). Incidence of *Mycoplasma* spp was not influenced by season (P>0.20). *Mycoplasma bovis* was the most common isolated species when compared to other *Mycoplasma* species (581 vs. 126 cases /year; P<0.005).The vast majority of both bulk milk tank samples and individual cow samples were characterized as no growth. In summary, among years, 1999 had the highest incidence of *Mycoplasma* spp and season did not affect this incidence. *Mycoplasma bovis* was the most abundant isolated species of *Mycoplasma* in bulk tank milk and individual cow samples.

Key Words: Mycoplasma, Milk Quality, Milk Samples

M17 Evaluation of Direct Fecal PCR and Serum ELISA for the Detection of *Mycobacterium avium* subsp. *paratuberculosis*. D. L. Clark*, J. J. Koziczkowski, R. P. Radcliff, R. A. Carlson, and J. L. E. Ellingson, *Marshfield Clinic*, *Marshfield, WI*.

Mycobacterium avium subsp. *paratuberculosis* (MAP) is the etiologic agent of Johne's disease in cattle. The disease causes diarrhea, reduced milk production, poor reproductivity, emaciation, and eventually death. Culture on Herrold's egg yolk agar (HEYA) is considered the gold standard for diagnosis of Johne's in cattle. Although sensitive and specific, the method can take up to 16 weeks due to slow growth of MAP. Currently serum ELISA is used to screen herds for Johne's disease but positive tests must be confirmed with culture or PCR. The current research sought to evaluate an in-house direct fecal PCR procedure and directly compare it to ELISA using culture as the gold standard. Serum and fecal samples were collected from cows (n=250) with unknown Johne's status. Fecal samples were processed for culture on HEYA and direct PCR. Serum samples were tested using the Parachek™ serum ELISA. Overall 67/250 (26.8%, 95% CI 21.4-32.8) animals were culturally confirmed as being infected. PCR and ELISA detected 74/250 (29.6% 95% CI 24-35.7) and 25/250 (10% 95% CI 6.6-14.4) respectively. Culture and PCR were able to detect more positive animals than ELISA ($P < 0.0001$). Overall, direct fecal PCR was 70.2% sensitive and 85.3% specific when using culture as the gold standard. The ELISA method was 31.3% sensitive and 97.8% specific. When culture reported < 10 CFU, the sensitivity and specificity of PCR and ELISA were 57.1% and 85.3%, and 4.8% and 97.8% respectively. When culture reported 11-39 CFU, the sensitivity of PCR and ELISA were 75% and 50% respectively. When culture reported > 40 CFU, the sensitivity of PCR and ELISA were 100% and 88.2% respectively. Specificity could not be calculated at these levels because there were no negative samples. Direct PCR out performed ELISA in diagnosing infected animals and was not significantly different when compared to culture. The direct fecal PCR method described here is economical, easy to use, and more accurate than the ELISA method. These data support the use of PCR as an alternative to culture for screening herds for prevalence and diagnosis of Johne's disease.

Key Words: Johne's, PCR, Paratuberculosis

M18 Effect of vitamin E and selenium administration on concentration of malondialdehyde in udder milk. P. Wicheanson[1], V. Harnpanichpun[2], V. Chupia[3], P. Vinitchaikul*[3], and W. Suriyasathaporn[3], [1]*Sixth year student, Faculty of Veterinary Medicine, Chiang Mai University*, *Muang, Chiang Mai, Thailand*, [2]*Dairy Product Research and Development Unit, Chiang Mai*, *Muang, Chiang Mai, Thailand*, [3]*Faculty of Veterinary Medicine, Chiang Mai University*, *Muang, Chiang Mai, Thailand*.

In response to mastitis, phagocytes generate superoxide to kill invading microorganisms, causing an increase of oxidative reaction in the udder. Although essential for survival, the undesirable repercussion of inappropriate or excessive oxidative reaction, the so-called oxidative stress, can cause tissue degeneration and consequently decrease in milk production. To reduce oxidative stress, it is possible that external administration of antioxidants might decrease oxidative stress in udder. The objective of this research was to determine the effect of vitamin E and selenium administration (Vit E-Se), an antioxidant, on concentrations of malondialdehyde (MDA), a oxidative stress marker, in udder milk. Fifty-eight dairy cows from six small holder farms in Chiang Mai were used. Milk samples were collected at morning milking. Twenty ml of commercial Vit E-Se with concentrations of 17 mg/ml of vitamin E and 1.67 mg/ml of selenium were administered after morning milking. Milk samples were collected at 6, 24, 72 hour after Vit E-Se administration. The samples was measured MDA with modified Smith's method. Due to data collected from the same cow, repeated measure analysis was used (Proc Mixed, SAS 8.0). MDA after Vit E-Se were compared with MDA before administration. Cow factor was defined as a repeated factor. Result shown that mean and SEM of MDA at before and after administration at 6th, 24th and 72nd hours were 1,370 +45, 1,133+28, 1,232+18 and 1,252+23 ppb, respectively. Concentration of MDA at before was higher than those after administration (p<0.05) There was no significant difference

of MDA between 24 and 72 hour after Vit E-Se. In conclusion, vitamin E and selenium administration result in decrease oxidative stress in udder.

Key Words: Vitamin E and Selenium, Dairy Milk, Malondialdehyde (MDA)

M19 Effect of feeding an immunostimulatory feed supplement (OmniGen-AF) during the dry period on somatic cell scores (SCS) in early lactation Holstein cows. H. T. Ballantine*[1], J. D. Chapman[2], Y.-Q Wang[4], and N. E. Forsberg[3,4], [1]*Ballantine Consulting*, *Hiram, GA*, [2]*Prince Agri Products*, *Quincy, IL*, [3]*Oregon State University*, *Corvallis*, [4]*OmniGen Research*, *Corvallis, OR*.

In previous studies, the feeding of a proprietary ingredient blend, OmniGen-AF (OG), (OmniGen-AF; Prince Agri Products) has been observed to increase the expression of markers of innate and acquired immunity. The goal of this study was to assess the hypothesis that OG, when fed to dry cows, had potential to reduce somatic cell scores (SCS) of cows in the subsequent lactation. The study was conducted on a commercial dairy in the southeast and included 114 Holstein cows. Cows were randomly assigned to one of two dry cow feeding regimens which consisted of a control ration program (0 g/h/d; n=46 cows) or a treatment ration program which consisted of feeding OG at 28 g/h/d to far-off dry cows and 56 g/h/d to close-up cows (n=68 cows). Animals were assigned to treatments as they entered the dry period over a period of 8 months. At freshening, all animals were managed similarly (i.e., no OmniGen-AF was fed during lactation). Milk production and SCS values were evaluated from monthly DHIA records and differences between treatment groups were assessed using ANOVA including treatment and parity as main effects. Addition of OG to the rations of dry cows had no effect on summit milk ($P>0.05$) which averaged 34.8 kg/day. SCS at the first DHIA test were not different ($P>0.05$) between the control (SCS=4.75) and OG-fed cows (SCS=4.45). SCS differences were detected between treatments at the second ($P=0.008$) and third ($P=0.022$) DHIA tests between control (SCS=5.31 and 4.78) and OG-fed cows (SCS=4.16 and 3.88). No differences in SCS were noted ($P=0.13$) between control and OG-fed dry cows animals at the fourth DHIA test. These results suggest that feeding OG during the dry period may be of benefit in reducing SCS in fresh cows in the subsequent lactation.

Key Words: OmniGen-AF, Somatic cells, Immunity

M20 Effect of intramammary treatment with Pirlimycin hydrochloride on antibiotic sensitivity of Gram-positive subclinical mastitis pathogens. M. D. Apparao, L. Oliveira, C. Hulland, and P. L. Ruegg*, *University of Wisconsin*, *Madison*.

The objective of this study was to evaluate the effect of intramammary treatment with pirlimycin hydrochloride on antibiotic sensitivity of subclinical mastitis pathogens. Cows (n = 254) from six WI dairy herds were screened for subclinical mastitis using the California Mastitis Test (CMT). Cows with at least one CMT positive quarter (n = 211) were randomly assigned to receive 50 mg intramammary pirlimycin in each positive quarter once daily for two consecutive days (labeled treatment) or no treatment. Duplicate aseptic milk samples were collected from all CMT positive quarters before treatment (pre-treatment) and 21 days after treatment (post-treatment). Target pathogens (Staphylococci spp and Streptococci spp.) isolated from milk samples were identified to the species level using laboratory procedures as defined by the NMC (1999). Treatment failures were defined as recovery of the same pathogen from pre and post-treatment milk samples. Cure was defined as absence of the causative pathogens or recovery of a different pathogen from the post treatment sample. Minimum Inhibitory Concentrations (MIC) were determined for Gram-positive pathogens using broth microdilution. Statistical analysis was done using PROC Univariate of SAS 9.1. Resistance was observed in 31% and 24% of pre and post treatment isolates, respectively. There was a significant difference between the pre- and post treatment MIC values for control quarters but no significant difference was observed for treated quarters. Microbiological cures were 37% and 52% for control and treated quarters, respectively. There was no association between results of antibiotic sensitivity testing and microbiological cures. Labeled usage of intramammary Pirlimycin had little short-term effect on the antibiotic sensitivity of Gram-positive subclinical mastitis pathogens but the outcomes of the sensitivity tests were poor predictors of microbiological cure of Gram-positive mastitis pathogens.

Key Words: Mastitis, Sensitivity Test, Antibiotics

M21 The effect of uterine infusion of ceftiofur in the immediate postpartum on lactation and reproduction in dairy cows. R. G. Bruno*, M. F. Sa Filho, F. S. Lima, V. J. A. Magalhaes, and J. E. P. Santos, *Veterinary Medicine Teaching and Research Center, University of California Davis*, *Tulare*.

Objectives were to evaluate the effect of intrauterine antibiotic treatment on lactation and reproduction in dairy cows. Holstein cows, 379, were randomly assigned to no treatment (CON, n=188), or a single uterine infusion (INF, n=191) of 500 mg of ceftiofur hydrochloride (Spectramast DC, Pfizer Animal Health) at 2 d in milk (DIM). Cows were presynchronized with two PGF2a injections at 37 and 51 DIM. Cows observed in estrus after the second PGF2a were inseminated, and those not in estrus received timed AI at 75 DIM. Ovaries were examined by ultrasonography at 35 and 42 DIM to determine cyclicity by the presence of a CL in at least one of the two examinations. Pregnancy was diagnosed at 38 and 66 d after the first AI. Yields of milk and milk components were measured once a month for the first 200 DIM. Survival and reproductive performance were evaluated for the first 240 DIM. Treatment did not affect ($P>0.10$) yields of milk and milk components and they were 39.5 and 39.0 Kg/d for milk, 1.39 and 1.35 kg/d for fat, and 1.18 and 1.17 Kg/d for true protein for CON and INF, respectively. Cows at high risk for uterine disease (retained placenta, milk fever, assisted calving, or twin calving) produced less ($P<0.01$) milk, fat and true protein than those at low risk. Infusion did not influence ($P=0.14$) prevalence of cyclic cows (50.9 vs 58.6%). Pregnancy rates at first AI were 30.4 and 29.7% for CON and INF ($P=0.88$). The median days open were similar ($P=0.18$) for CON and INF (170 vs 183 d). Similarly, survival time did not differ ($P=0.12$) between treatments and averaged 209 and 208 for CON and INF, respectively. Cows with subclinical endometritis had marked reduction ($P=0.02$) in first AI pregnancy rate (22.5 vs 34.3%) and extended ($P=0.01$) interval to pregnancy (189 vs 164 d). In summary, a single intrauterine infusion with 500 mg of ceftiofur did not improve lactation performance, resumption of ovulation, pregnancy rate at first AI and time to pregnancy, but cows with subclinical uterine inflammation had smaller pregnancy rate and extended interval to pregnancy.

Key Words: Ceftiofur, Dairy Cow, Reproduction

M22 Association of milk antimicrobial proteins with mastitis in dairy cattle. M. D. Person*, C. N. Person, T. D. Lester, and R. W. Rorie, *University of Arkansas*, *Fayetteville*.

Dairy cattle vary considerably in their susceptibility to mastitis, perhaps due to innate levels of milk antimicrobial proteins. This study evaluated the relationship between level of antimicrobial proteins in milk and incidence of mastitis. Milk samples were collected from 81 Holstein cows with at least three consecutive months of DHI records for somatic cell count (SCC). Composite milk samples were analyzed for the antimicrobial proteins, lysozyme, glucosaminidase, lactoferrin and lactoperoxidase. Based on SCC history and criteria established by DHIA, mastitis status of each cow was categorized as either new (SCC > 200,000 for the first time during current test date), chronic (SCC > 200,000 on two or more consecutive test dates), previous (classified as chronic previously, but current test SCC < 200,000), or no infection (SCC < 200,000). Levels of each of the milk antimicrobial proteins were then compared for cows in the four mastitis categories. Cows with new or chronic mastitis infections had higher (P = 0.0002) glucosaminidase levels (18.82 and 16.25 U, respectively) than cows with previous or no infection (9.31 and 9.26 U, respectively). Likewise, lactoferrin levels were higher (P = 0.008) for cows with new or chronic mastitis than for those with previous or no mastitis (141.78 and 99.92 versus 74.94 and 79.55 mg/L, respectively). No correlation was found between either lactoperoxidase (range of 970.77 to 1124.17 U/L) or lysozyme (range of 86.48 to 94.17 U/L) milk levels, and the mastitis categories (P = 0.6248 and 0.6830, respectively). Results suggest that glucosaminidase and lactoferrin increase in response to mastitis infection, rather than innate high levels of these proteins prevent mastitis since cows without mastitis had lower levels of these proteins than cows with infection. It is possible that a cow's ability to produce these proteins quickly in response to mastitis might reduce the severity and duration of infection.

Key Words: Mastitis, Cattle, Antimicrobial proteins

M23 Reduction of mortality and morbidity and increase in milk production in dairy livestock by plasmid-mediated growth hormone releasing hormone treatment during a period of high temperatures and humidity. P. A. Brown*, A. S. Khan, and R. Draghia-Akli, *ADViSYS Inc*, *Woodlands, TX*.

South Texas dairy farmers usually use a seasonal calving program to avoid the heat stress during the summer months. Pregnant Holstein heifers were relocated from South Dakota to Texas and calved June through September. The average temperatures and relative humidity (RH%) in South Texas resulting in high heat indexes (Table 1). In South Dakota, the climatic conditions would have been more favorable for calving (Table 1), We evaluated the potential of a plasmid-mediated growth hormone releasing hormone (GHRH) treatment to mitigate heat stress and its effects on the morbidity, mortality and milk production of treated animals and their offspring. In the third trimester of their pregnancy, thirty–two of the 52 heifers received 2.5 mg of a myogenic plasmid expressing a GHRH analog with increased half-life (pSP-HV-GHRH), while 20 heifers were used as controls. Body condition scores of treated animals vs. controls were statistically significantly better (3.55 vs. 3.35 at 60-80 days in milk (DIM), P < 0.0001), correlating with maintenance of IGF-I levels (P < 0.04) and body weights (r = 0.63). Hoof pathology was reduced with treatment. Involuntary culling of the pSP-HV-GHRH-treated animals was reduced by 40%. Mortality of heifers was significantly decreased (3% vs. 20% in controls, P < 0.003), while calves from treated heifers were 25% less likely to die at birth (18.8% vs. 25%), and from birth-to-260 days (0% vs. 20%). Overall calf mortality was reduced by 47%, P < 0.02. Calves from treated heifers were heavier at 260 days post-natal (P < 0.05). Milk production was increased by 10 to 22% (27.45 ± 0.89 kg/d vs. 23.2 ± 1 kg/d) in GHRH-treated animals compared to non-treated controls up to 300 DIM. This study demonstrates that treatment with a GHRH-expressing plasmid during the third trimester of pregnancy greatly improved the production, viability and general welfare of dairy cattle exposed to a four month period of high temperatures and humidity during late gestation and calving.

Climatic conditions in south Texas and South Dakota

	TEMP (°F)	Mean RH%	HEAT INDEX (°F)
Climatic conditions in Texas			
JUNE	90	70	106
JULY	89	65	99
AUG	91	64	105
SEPT	87	68	97
Climatic conditions in South Dakota			
JUNE	84	71	91
JULY	89	71	104
AUG	81	74	85
SEPT	76	73	76

Key Words: Dairy, Production, Heat Stress

M24 Factors affecting death rate of lactating cows in Dairy Herd Improvement herds. R. H. Miller, H. D. Norman*, M. T. Kuhn, and J. R. Wright, *Agricultural Research Service, USDA*, *Beltsville, MD*.

Frequencies of deaths of lactating cows of all breeds from 2001 through 2005 were estimated from an approximate 10% sample of US Dairy Herd Improvement herds (based on units position of herd code). Herds with <400 lactations across years were excluded. Because the trait is binomially distributed (0 = live; 1 = dead), PROC GENMOD of SAS was used. To prevent failure to converge, herds with a death rate of <0.3% were excluded. Data from 998,599 lactations (793 herds) were analyzed. The model included herd, year that lactation ended, month that lactation ended, and parity (1, 2, …, 7, ≥8). Actual death rate was 3.9% per lactation. All effects were significant ($P < 0.0001$). Chi-square values for herd, year, month, and parity were 14,826, 1,447, 209, and 6,990, respectively. Parameter estimates from GENMOD were expressed as least squares means on the binomial scale. Differences among months were small, but frequencies were slightly higher for lactations that ended in February and March. Death rate steadily increased with parity; estimates of parity differences relative to first parity were 0.8, 2.1, 3.1, 3.8, 4.3, 4.5, and 5.8% for parities 2, 3, 4, 5, 6, 7, and ≥8, respectively. Cows were 4 times more likely to die during eighth lactation and later than during first lactation. Death rates increased from 2001 to 2005; estimates of year differences relative to 2001 were 0.1, 0.5, 1.9, and 2.1% for 2002, 2003, 2004, and 2005, respectively. The sharp increase in frequency from 2003 to 2004 may have resulted from changes in regulations for disposal of downer cows.

Key Words: Death Rate, Longevity, Herdlife

M25 Identification of Monascus purpurea (red yeast) contamination of silages in the mid-West. G. Seiler[1], Y. Wang[2], and N. E. Forsberg*[2,3], [1]*Heartland Veterinary Services*, *Goddard, KS*, [2]*OmniGen Research*, *Corvallis, OR*, [3]*Oregon State University*, *Corvallis*.

The goal of this study was to identify a red mold common in silages on dairies in the mid-West and to determine whether it had potential to account for health challenges on dairy farms. This type of red mold is widely reported by dairy practitioners and can achieve sizes exceeding one foot in diameter. The red aspect of the mold is found in the interior of the ball and may not be visible from the exterior. The rationale for completing this study was that appearance of the mold coincided with appearance of several clinical signs which might be attributed to the presence of this mold. Clinical signs included multiple births, birth deformities, early embryonic mortality and toxic metritis. No changes in milk production were associated with the mold. A sample of molded silage was recovered and applied to Sabouraud culture plates containing antibiotics. Red-colored colonies were recovered and DNA was isolated using a Qiagen kit procedure. DNA from the isolated mold was amplified using pan-fungal primer sequences which specified a 550 bp fragment extending from the 16S ribosomal DNA to the 28S ribosomal subunit. The product spanned both the ITS-1 and -2 domains. The PCR product was sequenced and identified via a BLAST search. Identity of the DNA was Monascus purpurea (100% match to database), also known as "red yeast". Implications to the feeding of M. purpurea-infected silage are not certain but a review of the literature indicates that this yeast secretes citrinin (a nephrotoxin and mild hepatotoxin). Red yeast has been used as a nutritional supplement for humans to reduce cholesterol. Several cholesterol-lowering compounds are present in the yeast (monocolins) some of which are patented for cholesterol-lowering properties. These have been reported to effectively reduce liver HMG-CoA reductase activity. Others have also reported a similar mold in silages known as Monascus ruber. M. ruber lies within the same clade as M. purpurea and, like M. purpurea, produces citrinin and monocolins. Implications of Monascus spp. to livestock health warrant additional study.

Key Words: Silage, Monascus, Mold

M26 *Neotyphodium coenophialum* exposure reduces carcass mass and ribeye area, but not meat quality of growing steers grazing high versus low endophyte infected forages. K. R. Brown*[1], R. B. Cox[1], G. A. Anderson[1], G. K. Rentfrow[1], L. P. Bush[1], J. R. Strickland[2], J. A. Boling[1], and J. C. Matthews[1], [1]*University of Kentucky*, *Lexington*, [2]*Forage-Animal Production Research Unit, USDA-ARS*, *Lexington, KY*.

Steers that graze toxic endophyte-infected tall fescue before undergoing a finishing feed regimen generally have compromised growth during finishing and carcass characteristics at slaughter. The potential effects of consumption of toxic endophyte-infected tall fescue on growth, carcass quality, and postmortem parameters of growing Angus steers slaughtered off of pasture were examined. Steers were randomly allotted by weight to either a low-endophyte (LE; 6.8% infection) mixed grass fescue pasture (n = 9; BW = 266 ± 10.9 kg; 5.7 ha) or a high endophyte (HE; 62.8% infection) fescue pasture (n = 10; BW = 267 ± 14.5 kg; 5.7 ha) for at least 85 d. Shrunk BW was measured at d 0, 36, 57 and 85, and carcass parameters taken at slaughter (d 89, 91, 98, 103, or 105). ADG was greater ($P < 0.01$) for LE than for HE (0.40 vs -0.05 kg, respectively) from d 0 to 36, but no treatment difference was observed for ADG or BW for the overall 85 d period. However, BW at slaughter ($P < 0.05$; 338 vs 313 kg), hot carcass BW ($P < 0.01$; 172 vs 148 kg), and dressing percentage ($P < 0.01$) of LE steers were greater than for HE. Although 12th rib backfat thickness did not differ between LE and HE, the REA of LE steers was greater ($P < 0.01$; 60.3 vs 51.7 cm^2). No differences in pH, a^* , b^* , or shear force of REA steaks were observed between LE and HE on d 7, 14, or 21 postmortem. Although no treatment effects were observed for hue angle and chroma values, REA steak L^* values of LE steers were 1.3 to 2.0 units higher ($P < 0.04$) than for HE at d 7, 14, and 21. These results indicate that steers grazing fescue pastures with a high percentage of endophyte infection have reduced carcass mass and REA, but not indices of meat quality after 85–105 d of exposure.

Key Words: Endophyte, Fescue, Growing Steers

M27 Plasma metabolite and mineral levels of dry cows out–wintered on brassica forages. P. Gazzola*[1,2], L. Boyle[1], P. French[1], A. Hanlon[2], and F. Mulligan[2], [1]*Teagasc*, *Fermoy, County Cork, Ireland*, [2]*University College Dublin*, *Belfield, Dublin, Ireland*.

Maintaining cows on plots of brassica forages during the winter (out–wintering) is an attractive low–cost management system. The aim of this study was to evaluate plasma metabolite and mineral levels of dry cows out-wintered on kale (Maris Kestrel) and swedes (Marian) to cows housed indoors fed grass silage. Cows (n=22 per treatment) were blocked according to parity, liveweight, body condition score (BCS) and calving date, and randomly assigned to treatment. Cows were scored for BCS fortnightly. Blood samples were collected from cows within 1 wk of their expected calving date, and then again 1 wk post–calving. Non–esterified fatty acids (NEFA), beta–hydroxy butyrate (BHB) and glucose were evaluated from blood plasma to measure metabolic status. Minerals measured include calcium (Ca), phosphorous (P), magnesium (Mg), copper (Cu) and glutathione–peroxidase (GSH–Px). Data was tested for normality using SAS (9.1) and analyzed using a mixed model which included the number of days prior to/post bleeding as a factor, block as a random variable and the pre–calving values as a co–variate for post–calving values. Indoor cows had a higher BCS (3.67) prior to calving compared to cows on swedes (3.32) but not to kale (3.40; SE 0.125; $P<0.05$). No difference in NEFA, BHB or glucose was detected at either the pre or post calving stage. Out-wintered cows on kale had lower plasma Cu levels (15.0 µmol/L) compared to swedes (19.1) and indoor cows (20.2; SE 0.93; $P<0.001$). Alternatively, cows on kale had a higher ($P<0.05$) GSH–Px levels (96.4 units / g HB) compared to swedes (80.7) but not indoor cows (86.4; SE 5.4). No difference was detected for Ca, P or Mg at the pre or post stage. Metabolite levels did not indicate any negative effects of out-wintering cows on kale or swedes. Cows out-wintered on kale are at risk of copper deficiency copper.

Key Words: Brassicas, Dry Dairy Cow, Metabolic and Mineral Status

M28 Grazing high versus low endophyte-infected tall fescue reduces contractility of bovine lateral saphenous veins. J. L. Klotz*[1], K. R. Brown[2], L. P. Bush[2], J. C. Matthews[2], J. A. Boling[2], and J. R. Strickland[1], [1]*USDA-ARS, FAPRU*, *Lexington, KY*, [2]*University of Kentucky*, *Lexington*.

Cattle that graze toxic endophyte-infected tall fescue are continuously exposed to a myriad of toxins that are known to negatively affect cardiovascular tissues. As part of a larger study documenting the physiologic impact of grazing endophyte-infected tall fescue in growing cattle, the objective was to examine the vasoconstrictive activities of 5-hydroxytryptamine (5HT), α-methylserotonin (ME5HT; a $5HT_2$ receptor agonist), D-lysergic acid (LSA), and ergovaline (ERV) as affected by consumption of 2 levels of toxic endophyte infected tall fescue. Segments (2-3 cm) of the cranial branch of lateral saphenous vein were collected at time of slaughter from steers following an 89-105 d grazing period of either a low endophyte-infected (LE) mixed grass pasture (6.8% infection; n=8; BW=336±9 kg) or a high endophyte-infected (HE) tall fescue pasture (62.8% infection; n=8; BW=317±9 kg). Veins were sliced into 2-3 mm sections and suspended in a myograph chamber containing 5 mL of oxygenated Krebs-Henseleit buffer (95% O_2/5%CO_2; pH=7.4; 37°C) and allowed to equilibrate at 1 g of tension for 90 min. Increasing concentrations ($1x10^{-11}$ to $1x10^{-4}$ *M*) of 5HT, ME5HT, LSA, and ERV were administered every 15 min. Data were normalized (%) to contractile response induced by a reference dose of norepinephrine ($1x10^{-4}$ *M*) and data for each treatment were analyzed for effects of concentration and endophyte level. Maximal contractile intensities ($1x10^{-4}$ *M*) were greater ($P<0.05$) for steers grazing LE pastures than HE pastures for 5HT (73.3 vs 48.9±2.1%), ME5HT (52.7 vs 24.9±1.5%), and ERV (65.7 vs 49.1±2.6%). Onset of contractile response did not differ for 5HT and ERV, but onset of ME5HT contraction was delayed ($P<0.05$) in HE steers to 10^{-4} compared to 10^{-5} *M* in LE grazing steers. Grazing of HE pastures for 89-105 d appears to induce functional alterations in blood vessels, as evidenced by reduced contractile capacity and altered serotonergic receptor activity.

Key Words: Bovine, Fescue, Vasoconstriction

M29 Ergocryptine and ergonovine induced contractile responses in fescue naïve bovine lateral saphenous veins. J. L. Klotz*[1], B. H. Kirch[1], G. E. Aiken[1], L. P. Bush[2], B. C. Arrington[2], and J. R. Strickland[1], [1]*USDA-ARS, FAPRU*, *Lexington, KY*, [2]*University of Kentucky*, *Lexington*.

α-Ergocryptine (ERP; ergopeptine alkaloid) and ergonovine (ERN; ergoline alkaloid) are two alkaloids found in endophyte-infected tall fescue. Various alkaloids found in endophyte-infected tall fescue have been shown to elicit different effects in the grazing animal. As part of an ongoing characterization of vascular response generated by different alkaloids, the objective this study was to examine the vasoconstrictive potentials of ERP and ERN using bovine lateral saphenous veins (cranial branch) biopsied from fescue naïve cattle. Segments (2-3 cm) of vein were surgically biopsied from healthy cross-bred yearling cattle (n=6; 280 ±26 kg). Veins were trimmed of excess fat and connective tissue, sliced into 2-3 mm sections and suspended in a myograph chamber containing 5 mL of oxygenated Krebs-Henseleit buffer (95% O_2/5% CO_2; pH = 7.4; 37°C). Tissue was allowed to equilibrate at 1 g of tension for 90 min prior to initiation of treatment additions. Increasing doses of ERP or ERN ($1x10^{-11}$ to $1x10^{-4}$ *M*) were administered every 15 min following buffer replacement. Data were normalized as a percent of contractile response induced by a reference dose of norepinephrine ($1x10^{-4}$ *M*). Exposure of vein segments to increasing concentrations of ERP and ERN did not result in appreciable contractile response until $1x10^{-7}$ *M*. The two alkaloids did not differ in potency, but did in contractile intensity, with the $1x10^{-4}$ *M* response to ERN and ERP reaching maximums of 68.5 ±7.7% and 42.9 ±7.9%, respectively. The contractile response to increasing concentrations of ERN and ERP were opposite from previous evaluations of ergoline (e.g. lysergic acid) and ergopeptine (e.g. ergovaline) alkaloids using this bioassay, where the ergopeptine generated the greatest contractile intensity. This experiment demonstrates two additional causative agents that may be involved in the loss of vascular plasticity concomitant with consumption of toxic endophyte-infected tall fescue.

Key Words: Alkaloid, Bovine, Vasoconstriction

M30 Defining cutoff points for subclinical endometritis at different stages of lactation. K. N. Galvão*, S. B. Brittin, M. Frajblat, and R. O. Gilbert, *Cornell University*, *Ithca, NY*.

The objective was to define cutoff points for subclinical endometritis at different stages of lactation based on uterine cytology. Holstein cows (555), from 7 different herds, had uterine cytology performed at 21, 35, and 49±7 d in milk (DIM) and the proportion of each leukocyte type out of 200 cells counted, including epithelial and excluding erythrocytes, was recorded. Receiver operating characteristic (ROC) curves were performed at each time point to select the best cutoff point, for each leukocyte type, to predict pregnancy by 150 DIM. After selection of a cutoff point for significant predictors, time to conception was evaluated using Kaplan-Meier survival analysis. A Cox model including the effects of parity, BCS, PGF2a treatment before first AI, cyclicity by 49 DIM, plus each significant leukocyte predictor separately, was performed for 382 cows with complete information. Open cows were censored at 300 DIM. At 21 DIM, none of the leukocytes were significant predictors of pregnancy. The proportion of neutrophils (PMN) at 35 and 49 DIM tended to be a significant ($P=0.08$) predictor of pregnancy and the cutoff point was 3.0% PMN in both time points. This cutoff point resulted in significant ($P<0.01$) differences in time to conception at 35 DIM and in a tendency ($P=0.10$) at 49 DIM. Median d to conception was longer for cows with more than 3% PMN at 35 DIM (151 vs 121 d) and at 49 DIM (159 vs 131 d). For the Cox model that included PMN cutoff points, cyclicity by 49 DIM was the only significant variable and cyclic cows had increased ($P=0.01$) hazard of conceiving. The mere presence of one macrophage (LMN) was a significant ($P=0.04$) predictor at 49 DIM. The median d to conception was longer ($P<0.01$) for cows having LMN (169 vs 130 d) and resulted in lower ($P<0.01$) hazard of conceiving using the Cox model. Lymphocytes (SMN) were not significant ($P>0.15$) predictors at any stage. We infer from these data that leukocytes at 21 DIM, LMN at 35 DIM, and SMN at any stage are not diagnostic for subclinical endometritis and that the cutoff point for diagnosing subclinical endometritis should be 3% PMN at 35 and 49 DIM or the presence of LMN at 49 DIM.

Key Words: Endometritis, Dairy cow

M31 Effects of selection for post-weaning BW gain on carcass characteristics of *Bos indicus* and tropical adapted *Bos taurus* breeds. S. F. M. Bonilha*[1,2], L. O. Tedeschi[1], I. U. Packer[2], A. G. Razook[3], G. F. Alleoni[4], F. D. Resende[5], R. F. Nardon[4], and L. A. Figueiredo[3], [1]*Texas A&M University*, *College Station*, [2]*ESALQ/USP*, *Piracicaba, SP, Brazil*, [3]*Instituto de Zootecnia*, *Sertãozinho, SP, Brazil*, [4]*Insituto de Zootecnia*, *Nova Odessa, SP, Brazil*, [5]*APTA*, *Colina, SP, Brazil*.

A genetic program for selecting post-weaning growth performance of *Bos indicus* and tropical adapted *Bos taurus* (Caracu) breeds was initiated in 1976 at Sertãozinho Experimental Station (São Paulo, Brazil). Several studies have found a significant effect of genetic selection on ADG and body size, but few studies have thoroughly evaluated the impact of this genetic selection on carcass characteristics and meat quality. Therefore, the objective of this work was to evaluate carcass characteristics of the selected progenies. Adjusted BW at 378 days of 414 bulls of genetic selected herds (Caracu, Ca; Nellore, NeS; Guzerah, GuS; and Gir, Gi) and unselected herd (Nellore, NeC), born from 1992 to 1999, were used. Animals across years were fed different diets (TRT) either under feedlot or grazing conditions and were slaughtered, on average, with 653 days of age. Data were analyzed using a random coefficients model, considering herd as fixed and TRT within year and year as random effects. Initial BW was used as a covariate. The table below shows the least-square means of ADG; empty BW (EBW); KPH; HCW, dressing percentage (DP), hindquarter percentage (HQP), rib-eye area (REA), fat thickness (FT), and Warner-Bratzler shear force (WBSF). We concluded that despite a greater ADG, EBW, HCW for Ca and NeS compared to NeC and Gi ($P < 0.05$), KPH and carcass characteristics (REA, FT, and WBSF) did not differ ($P > 0.05$). This indicated the genetic selection of Nellore increased HCW without affecting carcass deposition, composition and meat quality.

	Ca	NeS	NeC	GuS	Gi
ADG, g/d	798^{a}	785^{a}	661^{b}	760^{ab}	612^{b}
EBW, kg	444^{a}	438^{a}	414^{b}	429^{ab}	409^{b}
KPH, kg	7.44^{a}	7.50^{a}	7.96^{a}	7.33^{a}	7.38^{a}
HCW, kg	279^{ab}	285^{a}	269^{b}	268^{b}	266^{b}
DP, %	55.2^{bc}	57.2^{a}	57.0^{ab}	55.0^{c}	57.1^{ab}
HQP, %	45.8^{b}	46.6^{a}	46.3^{ab}	46.2^{ab}	46.3^{ab}
REA, cm^2	57.8^{a}	53.9^{a}	57.5^{a}	51.8^{a}	52.4^{a}
FT, mm	13.2^{a}	14.8^{a}	15.6^{a}	15.4^{a}	15.5^{a}
WBSF, kg	4.00^{a}	4.76^{a}	4.89^{a}	4.93^{a}	5.48^{a}

Within a row, means without a common superscript letter differ ($P < 0.05$) by least-square means adjusted for Tukey.

Key Words: Development, Growth, Composition

M32 Gene expression analysis of pig muscle associated to cholesterol and fat parameters. A. Cánovas[1], J. Casellas*[1], L. Varona[1], I. Díaz[2], R. Quintanilla[1], and R. N. Pena[1], [1]*Genètica i Millora Animal. IRTA-Lleida*, *Lleida, Spain*, [2]*Tecnologia dels Aliments. IRTA-Monells*, *Monells, Spain*.

The objective of this study is to detect and identify genes involved in lipid metabolism in pigs. With this purpose, we have used a microarray approach over muscle samples. The animal material came from an experimental Duroc population of 370 castrated males distributed in five half-sib families. A total of 70 *Gluteus medius* (GM) muscle samples were processed, belonging to animals with the most extreme levels (HIGH and LOW lines; 35 animals per line) for cholesterol and fat parameters such as plasma lipoprotein and triglycerides concentration, percentage of intramuscular fat and fatty acid composition in muscle. Each sample was individually hybridized using *GeneChip Porcine Genome*® arrays (*Affymetrix*). After normalizing data with the RMA algorithm, comparison between lines was performed with two different analyses: a standard t-test and a Bayesian analysis by means of a mixed model with heterogeneous residual variances. The t-test results showed a total of 1,007 genes whose expression levels differed significantly (p-value$<10^{-7}$) between the HIGH and LOW lines. Among these significant genes, 140 had a ratio of expression between the two lines superior to 1.5. The mixed model analysis resulted in a total of 500 genes differently expressed at a significant level (p-value$<10^{-9}$), 158 of which showed a ratio between classes greater than 1.5. It is worth mentioning the high coincidence of genes detected with both analyses. The great majority of these 158 genes (95.5%) have a known human homonymous with biological functions related to a variety of processes such as: transcription factor, lipid metabolism and RNA processing.

Key Words: Cholesterol, Gene Expression, *Gluteus Medius*

M33 Positive association between porcine PTHLH gene and teat number in a F_2 Meishan and Iberian crossbreed. M. Martinez*[1], J.L. Noguera[1], O. Ramirez[2], E. Alves[3], and R.N. Pena[1], [1]*Genètica i Millora Animal. IRTA-Lleida.*, *Lleida. Spain*, [2]*Departament de Ciència Animal i dels Aliments. UAB.*, *Bellaterra. Spain*, [3]*Departamento de Mejora Genética Animal. SGIT-INIA.*, *Madrid. Spain*.

The differentiation factor PTHLH (parathyroid hormone-like hormone) has an established role as a local modulator of epithelial-mesenchymal interactions such as those of bone, teeth, mammary gland and nipple development. PTHLH is expressed in placenta and in a variety of tissues at embryonic stages; however its role in adult tissue has not been well reported. PTHLH-knock out mice die at birth from complications of a chondrodysplastic syndrome, while reduction of PTHLH receptor expression decreased mammary gland and nipple development. A QTL was observed for teat number in chromosome 5, where the PTHLH gene is located. Based on this, we are investigating the PTHLH gene as a candidate gene for nipple development in a Meishan × Iberian (Ms×Ib) F_2 experimental intercross. These breeds differ substantially in teat number. A C>T non-synonymous polymorphism has been characterized in the coding region of pig PTHLH gene. An allelic discrimination assay was carried out in parental, F_1 and F_2 Ms×Ib animals. Statistical analysis was performed with a fixed effects model which included genotype (3 levels) and generation (2 levels). Iberian boars were all homozygous for allele C while the SNP was found to segregate in Meishan sows being allele C the most frequent. For the association study we have used the first two generations (F_1 and F_2) of the crossbred because we lack teat number information in parental generation. We observed significant differences between homozygous for allele C (13.40±0.08) and the other two genotypes: heterozygous (13.80±0.10; P=0.0004) and homozygous for allele T (14.21±0.36; P=0.025). This result must be confirmed with alternative statistical

models that included the information provided by neutral markers. This study has been financed by the project AGL2004-08368-C03/GAN.

Key Words: Swine, Teat Number, Parathyroid Hormone-Like Hormone

M34 Rapid characterization of radiation hybrid panel DNA by SYBR® Green I-based dissociation curve analysis and application for river buffalo gene mapping. K. J. Kochan[1], M. E. J. Amaral[2], and P. K. Riggs*[1], [1]*Texas A&M University*, *College Station*, [2]*IBILCE, UNESP*, *São José do Rio Preto, Brasil*.

High quality genome maps are essential for identification of genes affecting economically important traits in domestic animals, yet genomic resources remain scarce for many agriculturally important livestock species, including the river buffalo (*Bubalus bubalis*). Meat and milk production from river buffalo is a valuable world commodity, but its genetic map has not been well characterized. Radiation hybrid DNA mapping panels are widely-used tools for the generation of gene maps in numerous vertebrate species. A radiation hybrid panel was recently developed for river buffalo, and a framework map is under construction. Efficient utilization of available resources is necessary for completion of this map, so the objective of this project was to reduce reagent and labor cost by adaptation of SYBR® Green-based real-time PCR and dissociation curve analysis methods for map construction. SYBR® Green I chemistry has been employed extensively in other real-time PCR applications, including quantification of gene expression, detection of mRNA splice variants and DNA sequence polymorphisms, and detection of bacterial and viral pathogens. Differences in fragment length or sequence composition of the PCR products can be distinguished by analysis of the dissociation curve. As an initial test of the application of this method, 30 bovine microsatellite markers were selected from the cattle genome map for analysis. These markers were tested by PCR amplification of DNA samples from a *Bos taurus* bull (positive control), river buffalo bull, and Chinese hamster A23 fibroblast cells. Of these markers, 26 (87%) amplified in river buffalo DNA and exhibited dissociation curves that were distinguishable between river buffalo and hamster, and were used to generate a map of chromosome 20 (BBU 20). Thus, this method can be used for fast and efficient mapping, and the necessity of gel electrophoresis and photodocumentation of gels has been eliminated, reducing overall cost. This technique can be employed for mapping of additional chromosomes to generate a whole genome river buffalo framework map.

Key Words: River Buffalo, Radiation Hybrid Mapping

M35 Comparison of ribosomal protein gene distribution between full-length enriched cDNA libraries from multiple stages of porcine early embryo. R. S. Wu*, E. -C. Lin, C. C. Hsu, and W. T. K. Cheng, *Department of Animal Science and Technology, National Taiwan University*, *Taipei, Taiwan*.

Preimplantation stage influences porcine early development. Ribosomal proteins are responsible for some basic functions to support the normality of embryogenesis during this period. In order to compare ribosomal protein gene expression between different stages of early embryo, the expressed sequence tags (ESTs) of ribosomal protein genes were extracted from porcine multiple embryonic stages: 4-cell, 8-cell, morula and early blastocyst. The strategy of the library construction is to generate full-length enriched cDNA library in early embryogenesis. Furthermore, the percentages of cDNA clones annotated were calculated as eighty ribosomal protein genes in the four libraries for statistical comparison of distribution for each ribosomal protein genes (4-cell vs. 8-cell; morula vs. early blastocyst). After cleaning those clones of low quality, short insertion and low complexity, the remaining sequences of high quality (N=31,339) were clustered into groups according to sequence similarity (≥ 95% identity and 90 bp minimum overlapping) to produce 1,378 clusters and 2,139 singletons. The ESTs of different ribosomal protein genes contained in the four libraries were different (4-cell: 10%, 8-cell: 6%, morula: 30% and early blastocyst: 63%). The ESTs frequency for 7 kinds of ribosomal protein genes were found to be significantly different between 4-cell and 8-cell embryos with R statistics from 12 to 47 (4-cell > 8-cell: 6 ; 8-cell > 4-cell: 1). As well, the ESTs frequency for 37 kinds of ribosomal protein genes were found to be significantly different between morula and early blastocyst with R statistics from 9 to 134 (morula > early blastocyst: 2 ; early blastocyst > morula: 35). The results described above showed that several ribosomal protein genes might be responsible for certain biological functions in the early embryogenesis in pigs.

Key Words: Ribosomal Protein, Early Embryogenesis, Pigs

M36 Use of random regression model in the milk yield analysis of water buffaloes. A. A. Ramos*[1], C. V. Araújo[2], S. I. Araújo[2], and D. C. P. Pereira[2], [1]*Sao Paulo State University*, *Botucatu, SP, Brazil*, [2]*Federal Rural University of Amazonia*, *Belém, PA, Brazil*.

Data comprising 1,719 milk yield controls of 357 females (predominantly Murrah breed) daughters of 110 sires, with births from 1974 to 2004, obtained from the Programa de Melhoramento Genético de Bubalinos (PROMEBUL) and also from records of EMBRAPA Amazónia Oriental - EAO herd, located in Belém, Pará State, were used to compare random regression models, for estimating variance components and predicting breeding values of the sires. Data of milk yield were analyzed by different random regression models using the Legendre's orthogonal polynomials functions of second, third and fourth orders. The random regression models included the effects of herd-year, month of parity date of the control; regression coefficients for age of females (in order to describe the fixed part of the lactation curve) and random regression coefficients related to the direct genetic effects and the permanent environment. The comparisons among the models were based on the Akaike Criteria Infromation. The random regression model that used the third order Legendre's polynomials and four class of the environmental effect was the one which better described the additive genetic variation of milk yield.The heritability estimates varied from 0.08 to 0.40. The genetic correlation between milk yields in younger ages was close to the unit, but in older ages was low.

Key Words: Genetic Evaluation, Murrah Breed, Milk Yield

M37 Effects of cytoplasmic line on scrotal circumference and semen quality traits in Angus bulls. A. G. Garmyn* and D. W. Moser, *Kansas State University*, *Manhattan*.

The purpose of this study was to estimate the heritability of semen traits, genetic correlations between scrotal circumference (SC) and

semen quality parameters, and the effect of cytoplasmic line on semen traits. Breeding soundness exam (BSE) data was collected on registered Angus bulls at four ranches over seven years. The American Angus Association provided historical pedigree information to estimate the effect of cytoplasmic line on SC and semen quality traits. After editing, the evaluated dataset contained 1,281 bulls with BSE data that traced to 100 founder dams. Data were analyzed using a two-trait animal model to obtain heritability, genetic correlation between SC and semen quality traits, as well as the effect of cytoplasmic line as a random effect for SC, percent motility (MOT), percent primary abnormalities (PRIM), percent secondary abnormalities (SEC), and percent total abnormalities (TOT) using MTDFREML. Fixed effects included source ranch and birth year, and test age was used as a covariate. Estimates of heritability for SC, MOT, PRIM, SEC and TOT were 0.46, 0.05, 0.27, 0.24, and 0.25, respectively. Genetic correlations between SC and MOT, PRIM, SEC, and TOT were 0.37, -0.20, -0.13, and -0.25, respectively. The proportions of phenotypic variance accounted for by cytoplasmic line for SC, MOT, PRIM, SEC, and TOT were <0.001, 0.013, 0.022, 0.0023, and <0.001, respectively. Genetic correlations between SC and semen quality traits were low to moderate and favorable. Cytoplasmic line may have a marginal effect on MOT and PRIM, but is likely not a significant source of variation for SC, SEC, or TOT.

Key Words: Bulls, Cytoplasmic Line, Semen

M38 Effect of temperature and humidity on gestation length. H. D. Norman, J. R. Wright*, and J. B. Cole, *Agricultural Research Service, USDA*, *Beltsville, MD*.

High temperature and humidity have been shown to suppress daily milk and component yields of dairy cows, but their effects on most other performance traits have not been investigated. To determine if monthly differences in GL are caused by temperature and humidity, meteorological data since 1997 recorded at 238 weather stations was used in conjunction with national data for nearly 7 million calvings from 1999 through 2005. Temperature and relative humidity recorded at the weather station closest to the herd were combined into temperature-humidity indexes (THI): THI = (1.8T + 32) – (0.55 – 0.0055H)(1.8T – 28), where T is temperature in °C and H is relative humidity expressed as a percentage, for the week prior to calving and for calving day. Effect of weekly and calving-day THI on GL were compared with a model that accounted for THI, calving day, calving year, calving herd-year, calving month, age-parity, calf birth code (gender and multiple-birth status), lactation length, milk yield, service sire, sire, and cow. All effects were fixed except service sire, sire, and cow. Effect of THI on GL without calving month in the model also was examined. When weekly THI was 36 to 40, 56 to 60, and 76 to 80 with calving month in the model, GL was 279.7, 279.5, and 279.1 d, respectively; without calving month in the model, GL was 280.2, 279.8, and 278.6 d. Excluding calving month from the model resulted in greater variation in GL, which became shorter at an accelerated rate as THI increased. Calving-day THI were less effective than weekly THI in accounting for GL differences. Although the benefit of including THI in the model was rather limited if calving month was already considered, GL still became noticeably shorter when THI was >70. Either calving month or THI can be effective in helping to predict calving dates.

Key Words: Gestation Length, Heat stress, Temperature-Humidity Index

M39 Relationship of gestation length to stillbirth. R. L. Powell*, H. D. Norman, and J. R. Wright, *Agricultural Research Service, USDA*, *Beltsville, MD*.

Gestation length (GL) has economic and management effects, but its relationship to stillbirth (SB) has not been well documented. Mean Holstein SB rate by GL was examined using >800,000 Holstein calvings with SB data from 1999 through 2005. Data were limited to calvings with a GL of 260 to 295 d from herds with ≥15 calvings with SB data that included ≥3 reported SB. The SB rate was 17.8% for GL of <270 d, 5.0% for GL of 278 to 282 d, and 8.1% for GL of >290 d. Genetic parameters for SB were estimated with a linear model that included fixed effects for calving year, calving herd-year, age-parity, calf birth code (gender and multiple-birth status), lactation length, and milk yield and random effects for service sire, sire, and cow. Effect of calving year on SB rate was small. The SB rate was 1.5% higher for calvings in December and January compared with April to June, 2% higher for lactations of >500 d compared with <250 d, and 2% higher for milk yield of <6,000 kg compared with >16,000 kg. Multiple birth tripled SB rate. Heritability estimates for SB were 0.6% for service sire and 1.2% for sire (2.3% and 4.6%, respectively, when transformed to an assumed underlying scale); heritabilities for February 2007 USDA SB evaluations, which are calculated with a threshold model, were 3.0% for service sire and 5.8% for sire. Correlations of calculated service-sire and sire SB predicted transmitting abilities (PTA) with corresponding February 2007 USDA SB PTA were 0.77 and 0.82 for bulls with >100 daughters with SB data. Correlations of GL PTA, which accounted for the same effects as for SB PTA, with February 2007 USDA SB PTA were 0.20 for service-sire traits and 0.03 for sire traits for bulls with ≥100 observations for each trait (1,613 service sires; 1,040 sires). Of those bulls that were in active artificial-insemination service (132 service sires; 109 sires), corresponding correlations were 0.38 and 0.09. Linear regression of SB PTA on GL PTA showed a 0.07% increase in service sire SB PTA ($P > 0.05$) and a 0.14% increase in sire SB PTA ($P < 0.0001$) for each 1-d increase in corresponding GL PTA.

Key Words: Genetic Evaluation, Stillbirth, Gestation Length

M40 Genomic structure and polymorphisms of the bovine c21orf66 gene. K. R. Wunderlich*, C. A. Abbey, and C. A. Gill, *Texas A&M University*, *College Station*.

The c21orf66 gene is a putative transcription factor with no known function that lies within the polled interval on BTA1. In humans, this gene spans approximately 37,000 bp and alternative splicing results in at least 4 variant isoforms. The objective of this study was to evaluate this gene as a positional candidate for polled and characterize the genomic structure of this gene in bovine. In order to characterize c21orf66, we assembled bovine whole-genome shotgun, bacterial artificial chromosome, expressed sequence tag, and in-house sequence data into a contig spanning over 50,000 bases to include c21orf66, its promoter, and its 3' end. As in humans and mice, and based on this sequence information, this gene has 18 exons. The contig also served as a reference sequence for SNP discovery through the sequencing of 93 animals from within a breed panel consisting of Angus, horned Hereford, polled Hereford, Ankole, Brahman, Nelore, and Simmental. Single nucleotide polymorphisms within breeds were identified using polyPHRED followed by manual verification in Consed, and then consensus sequences were compared between breeds. The number of confirmed SNPs within c21orf66 for each individual breed varied from

29 to 98 with a total of 145 SNPs discovered across all breeds. The average spacing between SNPs was 363 bp and the average ratio for transitions vs. transverions was 1:2.6. Additionally, 7 indels were also discovered. However, no single SNP or insertion/deletion discovered is consistently different between the horned and polled consensus sequences and thus cannot be attributed as the causative mutation for polled.

Key Words: c21orf66, Bovine, SNP

M41 Application of the Sleeping Beauty transposon system to avian cells. B-W. Kong*[1], L. K. Foster[2], and D. N. Foster[2], [1]*University of Arkansas*, *Fayetteville*, [2]*University of Minnesota*, *St. Paul*.

The Sleeping Beauty (SB) transposon system is a member of the Tc1/mariner superfamily of DNA transposable elements which have been reconstructed from inactive elements found in salmonids fish. The SB system was developed for gene therapy and mutagenesis in human and mouse species, and until now, has not been shown to function in chicken and turkey cells as a molecular tool for avian transgenesis and chromosome engineering. The transposon construct was generated using the antibiotic (puromycin) selectable marker flanked by the Sleeping Beauty repeat sequences in the improved transposon vector, pT2 (pT2/Puro). To test the ability of SB-mediated transposition in avian species, immortal DF-1 chicken embryo fibroblast (CEF), breast-derived CEF (BCEF) and turkey turbinate-derived (TT-1) cell lines were transfected with a selectable transposon (pT2/puro) vector with or without the transposase (pCMV/SB) vector. Following antibiotic selection, resistant foci were stained and counted to determine relative transposition frequencies. DF-1 CEF cells co-transfected with the transposon and SB vector (pT2/puro + pCMV/SB) showed an approximate 1300-fold increase in the number of foci, compared to the non-transposon vector control (pCMV/puro). When SB mediated transposition was compared to non-SB mediated transposition, the SB co-transfected immortal TT-1, BCEF, and DF-1 CEF cells showed approximately 15-, 20-, and 40-fold increases in the number of puromycin resistant colonies, respectively. This suggests that the ″cut and paste″ manner of foreign gene insertion into genomic DNA using SB system possibly could be more effective than the nicking mechanism for the incorporation of a non-transposable expression vector. Of interest, primary CEF cells did not show significant increased SB-mediated transfection or transposition efficiencies, suggesting that a more efficient transfection method is needed in order to apply SB-mediated transposition in primary avian cells. In conclusion, we have demonstrated that the SB transposon system can be utilized for the mutagenesis of avian cultured cells.

Key Words: Sleeping Beauty Transposon, Mutagenesis, Avian Cell Lines

M42 Evaluation of growth traits of Brazilian herefords using multivariate analysis. J. C. Souza*[1,2], L. T. Campos[3], J. A. Freitas[2], R. Weaber[4], and W. R. Lamberson[4], [1]*Scholarship of CNPq*, *Brazil*, [2]*Parana Federal University*, *Palontina, Brazil*, [3]*Engenheiro Agronomo*, *Brazil*, [4]*Univeristy of Missouri*, *Columbia*.

The objective was to evaluate growth and conformation of Brazilian Herefords using principal component (PC) analysis. Traits analyzed included birth weight (BW); weaning weight (WWT); weight adjusted to 205 d (W205); daily and total gain birth to weaning (DGBW, TGBW); observed yearling weight (OW365); weight adjusted to 365 d (W365); daily and total gain weaning to yearling (DGWY, TGWY) and scores of conformation (CS); maturity (MAT); muscle (MS); and frame (FS). Eigenvalues of the first three PC were 5.33 (41%), 3.75 (29%) and 2.03 (16%). The correlations among W205, DGWT and W365 were high and positive as were those among CS, MAT, MS, and FS, but were near zero between these sets of traits. Traits contributing most to the first PC were W365 (0.40) and W205 (0.38), to the second PC were CS (0.48), MAT, MS and FS (0.47). Genetic parameters for W205, W365 and PC1 were estimated with MTDFREML using a univariate animal model fitting contemporary group (year, herd, management, season and sex) and age of dam (linear and quadratic covariate) as fixed effects and direct and maternal genetic, their covariance, and uncorrelated maternal permanent environment (c^2) as random effects. For W205, W365 and PC1, respectively, estimates of direct h^2 were 0.22 ± 0.14; 0.50 ± 0.02; 0.44 ± 0.03; of maternal h^2 were 0.13 ± 0.02; 0.13 ± 0.02; 0.14 ± 0.04; and c^2 were 0.07 ± 0.10; 0.07 ± 0.01; 0.09 ± 0.02 and correlations between direct and maternal genetic effects were -0.67 ± 0.04; -0.80 ± 0.03;-0.64 ± 0.06. Both direct and maternal heritabilities were of expected magnitude as was the negative direct-maternal correlation. The first principal component, weighted heavily toward growth traits, had similar estimates of genetic parameters. Principal components can be used to consolidate correlated traits into a simpler set of groupings.

Key Words: Beef Cattle, Growth, Heritability

M43 Molecular evidence that turkey varieties belong to a single breed. E. Smith*, J. Xu, X. Guan, T. Geng, and D. Kamara, *Virginia Polytechnic Institute and State University*, *Blacksburg*.

Using a total of 250 birds from seven varieties, we investigated the relatedness among and within different populations of the domestic turkey, Meleagris gallopavo. The molecular markers used in the investigation were obtained from both nuclear and mitochondrial genome. From the nuclear genome, the markers used were microsatellite, SNP, and RAPD-based. The mitochondrial-based markers, developed from the whole genome sequence obtained for this work and submitted to GenBank (Accession number assigned is EF_153719) were d-loop and 16S rRNA-based. In addition to variants in the mitochondria, a total of 15 markers formed the basis of the analyses. Together, the analyses suggest that except for the Royal Palm, the turkey varieties are very closely related with a higher genetic variation within than among the populations. The Royal Palm appears to be distant from all the varieties including the commercial turkey as alleles of several distinct markers and marker-types were absent in other varieties but fixed in the Royal Palm populations. The Royal Palm appears to be distant from all the varieties including the commercial turkey, as alleles of several distinct markers and marker-types were absent in other varieties but fixed in the Royal Palm populations. However, consistent with morphological reports, results suggest that turkey varieties originated from a single breed.

Key Words: Turkey, Varieties, Molecular Phylogeny

M44 Evaluation of nucleolar proliferating protein 1 as a candidate gene for beef carcass characteristics. J. H. Bosques-Méndez*[1], M. Pagan[1], E. Casas[2], A. Casas[1], and D. Cianzio[1], [1]*University of Puerto Rico*, *Mayagüez, Puerto Rico*, [2]*Roman L. Hruska USDA MARC*, *Clay Center, NE*.

Single nucleotide polymorphisms (SNP) identified in four regions of nucleolar proliferating protein 1 (Nol1: A, B, C and D) were evaluated for associations with carcass traits. Genotyping was performed in a group of 42 Senepol x Charolais and Angus × Charolais crossbred bulls grazing tropical grass from weaning to harvest. Nol1-A was associated (P<0.05) with shrinkage percentage (SH), Obliquous muscle weight (OM; kg), trimmed fat (TF; kg), and dressing percentage (DP). Animals inheriting the TT and CT genotype had greater SH, OM and DP than those inheriting the CC genotype. Nol1-B was associated (P<0.05) with SH, left hindquarter weight (LHQ; kg), OM, hindquarter percentage (HQP), frontquarter percentage (FQP), total muscle weight (TMW; kg), and slaughter weight (SW; kg). Animals with the CC and CT genotypes were heavier than those inheriting the TT genotype. Associations (P<0.05) between Nol1-C and SH, Gastrocnemius muscle weight (GM; kg), TF, LHQ and TMW were detected. Animals having the AA genotype had greater values for SH and GM compared with animals with the AG and GG genotypes. Animals inheriting the GG genotype had greater TF than the other genotypic groups. For Nol1-D, associations where ascertained for HQP, FQP, LHQ, TMW. No animals inherited the AA genotype, but AG animals had greater values for HQP, LHQ and TMW. Although larger studies need to be conducted, results from this study indicate that markers at the nuclear proliferating protein 1 gene are associated with important carcass traits for beef cattle in the tropics.

Key Words: Nol1, SNP, Carcass

M45 Application of Wilmink's function to Bayesian inference of heritability for monthly test day milk yields in Iranian Holsteins. H. Farhangfar*, *Birjand University*, *Birjand, Iran*.

To estimate heritability of individual monthly test day milk yields in Iranian Holstein heifers, a total of 32854 test day records collected from 3842 first lactation Holsteins (progeny of 466 sires) calving from 2001 to 2005 and distributed in 125 herds of Razavi Khorasan province of Iran was used. Bayesian statistical method via Gibbs sampling technique in a random regression test day animal model was applied. In the random regression model, fixed environmental effect of herd-year-month of test-milking times (as contemporary group with 1359 levels), covariables (linear and quadratic) of cow age at calving, linear covariable of Holstein gene as well as random effects of direct additive genetic and permanent environment were included. Wilmink's function ($y = a + bt + c(Exp(-0.05t))$) was also included in the random regression test day model as a sub-model to take account of milk yield variation over the course of the lactation at two genetic and environmental levels. Heterogeneous environmental variance was assumed over the course of lactation. The analysis was undertaken using RRGIBBS software in which Bayesian heritability estimates of test day milk yields were obtained through 50000 rounds Gibbs sampling from which the first 10000 chains was considered as burn-in period. The lowest and greatest heritabilities were obtained for months 2 (0.236) and 10 (0.361) of the lactation period respectively. The results of the present research also showed that permanent environmental variance as a proportion of the phenotypic variance were maximum (0.625) and minimum (0.337) for the first and fourth month of the lactation course.

Key Words: Wilmink's Function, Bayesian Estimate, Iranian Holstein

M46 Bivariate genetic analysis of monthly test day milk yield and protein percentage for Holstein heifers in Khorasan province of Iran. H. Farhangfar*, R. Lotfi, and H. Naeemipour, *Birjand University*, *Birjand, Iran*.

In this study a bivariate animal model was used to estimate genetic parameters of monthly test day milk yield and protein percentage for Holstein heifers in Khorasan province of Iran. The data was 27673 monthly test day records obtained from 4125 first lactation cows (representing 430 sires and 3744 dams) calving between 2002 and 2005 in 113 herds. The average milk yield and protein percentage over the course of the lactation were 28.69 Kg and 3.27% respectively. In the repeatability test day model, the environmental factors were the combined effect of herd-year-season of production (as contemporary group), stage of lactation, milking times, covariables of Holstein gene (linear) and age of cow at recording (linear and quadratic). Random effects of direct additive genetic as well as permanent environment were also included in the model. Genetic and environmental variance and covariance components were estimated by AI-REML algorithm implemented in DMU package. The results obtained in the present study showed that the heritabilities of milk yield and protein percentage were 0.100 and 0.048 respectively. Additive genetic, permanent and temporary environment correlations between the traits were -0.147, -0.713 and -0.069 respectively. Repeatability estimate of monthly test day milk yield was found to be 0.601 while the corresponding estimate for monthly test day protein percentage was 0.092.

Key Words: Animal Model, Heritability, Iranian Holstein

M47 Insemination of Holstein cows with sexed sperm. J. L. Schenk*[1] and R. W. Everett[2], [1]*XY, Inc.*, *Fort Collins, CO*, [2]*Cornell University*, *Ithaca, NY*.

Most research with sex-sorted sperm has been limited to heifers. The objective of this field trial was to determine pregnancy rates in lactating dairy cows following AI of frozen-thawed X-chromosome-bearing sperm. Sperm were sorted with a MoFlo® SX flow cytometer on the basis of DNA content, targeting 90% purity of X-sperm. Holstein cows (N=2197), lactations 1 - 4 and 20 - 140 DIM were inseminated 12 or 24 h after synchronized ($PGF_{2\alpha}$ or Ovsynch) or natural estrus. Three experimental treatments, unsorted control (20 x 10^6 sperm/dose) in 0.25 mL straws and sex-sorted (2 x 10^6 sperm/dose) in 0.25 mL or 0.5 mL straws, were balanced over 3 Holstein bulls. Equal numbers of straws of each treatment x bull combination were distributed to 7 commercial dairies. AI services were limited to two per cow and performed by multiple technicians. Pregnancy was determined via rectal palpation at ~60 d after insemination. Data were analyzed with a mixed model ANOVA that included environmental and biological variables known to influence pregnancy rates in cows. Pregnancy rates from sexed sperm were similar (P>.05) for 0.25 mL (25.0%) and 0.5 mL (24.4%) straws, but different (P<.001) from controls (37.7%). Pregnancy rates with sexed sperm were >12 percentage points lower than those for unsexed sperm (64% of controls). Pregnancy rates for

sexed sperm after 84 - 98 DIM were 7.9 percentage points higher than earlier in lactation and >6 percentage points lower in 3rd and 4th lactation cows compared to 2nd lactation cows. The range of differences between bulls (6.7 percentage points; P<.001) was consistent across treatments. Pregnancy rates were similar between cows synchronized with $PGF_{2\alpha}$ or Ovsynch (P>.05), but 15 percentage points higher for natural estrus compared to Ovsynch (P<.001). Use of sexed sperm will reduce pregnancy rates ~12 percentage points compared to unsexed sperm in lactataing cows. Limiting use of sexed sperm to 1st and 2nd lactation cows after an elective postpartum waiting period of >100 DIM will yield the highest pregnancy rates with sexed and unsexed sperm.

Key Words: Dairy Cows, Pregnancy, Sexed Sperm

M48 Genetic trends for dairy traits in the Holstein x Other Breeds multibreed dairy cattle population in tropical central Thailand. S. Koonawootrittriron[1], M. A. Elzo*[2], and T. Tongprapi[3], [1]*Kasetsart University*, *Bangkok, Thailand*, [2]*University of Florida*, *Gainesville*, [3]*Dairy Farming Promotion Organization*, *Saraburi, Thailand*.

There has been a concerted effort to increase milk production in Thailand over the past 35 years. This effort has been a combination of government policies, importation and widespread use of Holstein semen, and extensive use of high percent Holstein sires generated in Thailand. This mating strategy has resulted in a multibreed dairy population where 90% of animals are 75% Holstein or greater. Central Thailand is the most important dairy region. The objective of this research was to assess genetic variability and genetic trends for 305-d milk yield (MY), 305-d fat yield (FY), and average 305-d fat percent (FP) in Central Thailand from 1991 to 2005. Data consisted of 15,260 monthly test-day records from 1,377 first-lactation cows collected in 92 farms from 1991 to 2005. Dairies in Thailand maintain cows in open barns, and less than 10% use fans to reduce heat stress. Estimates of variance and covariance components and breeding values (EBV) were obtained using a multiple-trait animal model. Fixed effects were contemporary group (herd-year-season), calving age, and additive genetic group as a function of Holstein fraction. Random effects were animal and residual. Program ASREML was used to perform computations. Estimates of heritabilities were 0.39 ± 0.10 for MY, 0.26 ± 0.10 for FY, and 0.21 ± 0.11 for FP. Although the difference between the mean MY for cows in 2005 and 1991 was 79.3 kg, the regression of mean cow EBV for MY on year was only 0.9 kg/yr. Differences between mean cow EBV for FY and FP in 1991 and 2005 and their corresponding regressions of mean FY and FP on year were all near zero. Similarly, mean EBV for sires and dams of cows also showed near zero trends during these years. The absence of genetic trends suggests that high percent Holstein cows are not reaching their production potential under the management, nutrition, and hot and humid climatic conditions in this tropical region.

Key Words: Multibreed, Cattle, Tropical

M49 Multi-trait evaluation for calving ease and stillbirth with separate genetic effects by parity. G. R. Wiggans, J. C. Cole, and L. L. M. Thornton*, *Agricultural Research Service, USDA*, *Beltsville, MD*.

Genetic evaluations for calving ease and stillbirth were calculated with Holstein and Brown Swiss data from 14,164,522 calving reports in the USDA national dairy database. Calving ease was measured on a scale of 1 (no difficulty) to 5 (difficult birth); stillbirth status was designated as live or dead within 48 hr. Calving-ease scores were transformed separately for first and later parities and calf gender. The score used in the analysis was on a unit standard deviation scale in the middle of the range for each score. Stillbirth status was present for 53% of calving-ease observations. Variance components were estimated from a 103,909-record Holstein sample with no missing observations, which represented the 2,999 bulls with the most data. For calving ease and stillbirth in first and later parities, a multitrait sire-maternal grandsire (MGS) linear model included fixed effects for year-season, gender, sire birth year, and MGS birth year and random effects for herd-year interaction, sire, and MGS was applied. For later parities, gender effects were separated by parity. The correlation between first and later parities was 0.69 for sire and 0.19 for MGS solutions for calving ease and 0.84 for sire and 0.78 for MGS solutions for stillbirth. For first-parity, the correlation between calving ease and stillbirth was 0.86 for sire and 0.34 for MGS solutions. To calculate national evaluations for Holstein and Brown Swiss, a fixed effect for breed was added to the model. Correlations between solutions on the underlying scale from the current evaluation with those from this analysis averaged 0.85 for sire and 0.80 for MGS for calving ease and 0.67 for sire and 0.70 for MGS for stillbirth. The multitrait analysis provided stillbirth evaluations for bulls with missing observations based on correlated calving-ease data and accounted for genetic differences in calving performance between first and later parities. Evaluation stability should be improved as the portion of observations from different parities changes. Accuracy of the net merit index can be improved by adjusting weights to use evaluations for separate parities optimally.

Key Words: Calving Traits, Dystocia, Stillbirth

M50 Estimation of genetic parameters for milk and fat yields in Holstein cattle of Khorasan province of Iran. H. Naeemipour*[1], H. Farhangfar[1], H. Moravej[2], M. Rokoei[3], and M. B. Sayyadnejad[4], [1]*Birjand University*, *Birjand, Khorasan, Iran*, [2]*Tehran University*, *Tehran, Tehran, Iran*, [3]*Zabol University*, *Zabol, Sistan va Bluchestan, Iran*, [4]*Animal Breeding Center*, *Karaj, Tehran, Iran*.

In order to estimate genetic parameters for milk and fat yields in Holsteins of Khorasan province of Iran, a total of 17791 records belonging to 26078 cows calving from 1990 to 2003 and distributed in 133 herds was used. The data was recorded by animal breeding center of Iran. Two separate analyses consisting of bi-variate (first lactation milk and fat yields) and four-variate (first and second lactation milk and fat yields) animal models were undertaken. In the models, fixed effect of herd-year-season of calving, age at first calving (linear and quadratic covariates) as well as the random effect of additive genetic were included. Additive genetic and environmental (co)variance components were estimated for the traits under consideration applying restricted maximum likelihood method based upon derivative-free algorithm. The results obtained in the present study indicated that heritability estimates of milk and fat yields were 0.28 and 0.23 respectively in bi-variate model. In four-variate model, the heritability estimates of milk yield were 0.29 (at first lactation) and 0.23 (at second lactation) while the corresponding figures for fat yield were found to be 0.24 and 0.21 respectively.

Key Words: Genetic Parameters, Holstein, Khorasan Province of Iran

M51 REML heritability and repeatability estimates of net energy for lactation trait for Holstein heifers in Khorasan province of Iran. H. Farhangfar*[1], H. Naeemipour[1], R. Lotfi[1], and M. Pajaz[2], [1]*Birjand University*, *Birjand, Iran*, [2]*Jihade Agriculture of Razavi Khorasan*, *Mashhad, Iran*.

In this study, a total of 24473 monthly test day records of net energy for lactation (NEL in terms of Mcal/kg) obtained from 3805 Iranian Holstein heifers (representing 423 sires and 3474 dams) calving between 2002 and 2005 and distributed in 112 herds was used to estimate heritability and repeatability. A repeatability fixed regression test day animal model was fitted to the data. In the model, fixed environmental effects of herd-year-season of calving-milking times-stage of lactation, age at calving (linear and quadratic covariates), Holstein genes (linear and quadratic covariates) and daily milk yield (linear and quadratic covariates), and random direct additive genetic and permanent environmental effects were included. Restricted maximum likelihood (REML) estimates of heritability and repeatability of NEL were obtained by DFREML software. The results showed that NEL had a heritability of 0.05 indicating that there was low direct genetic variation among cows to be selected in a genetic evaluation. For this trait the same figure was also observed for repeatability suggesting that non-significant permanent environmental variation was found during the course of lactation.

Key Words: Net Energy for Lactation, Genetic Parameters, Iranian Holsteins

M52 Genetic evaluation of lactation persistency estimated by best prediction for Ayrshire, Brown Swiss, Guernsey, and Milking Shorthorn dairy cattle. J. B. Cole and D. J. Null*, *Animal Improvement Programs Laboratory, USDA*, *Beltsville, MD*.

The objectives of this study were to calculate (co)variance components and breeding values for best predictions of persistency of milk (M), fat (F), protein (P), and SCS in Ayrshire (AY), Brown Swiss (BS), Guernsey (GU), and Milking Shorthorn (MS) dairy cattle. Cows with high persistency tend to milk less than expected at the beginning of lactation and more than expected at the end. Persistency was calculated as a function of a trait-specific standard lactation curve and the linear regression of a cow's test day deviations on days in milk. Heritabilities represent the additive genetic variance of persistency that is independent of yield and defined to have a phenotypic variance of 1. Available data ranged from 27,964 (MS) to 159,898 (BS) records for cows calving since 1997. The number of active AI sires receiving evaluations for persistency ranged from 4 (MS) to 39 (BS). Results from the four breeds were similar; only BS results are presented (Table 1). Sire EBV for persistency of M, F, and P were similar and ranged from -0.36 to 0.67 for M; EBV for persistency of SCS ranged from -0.40 to 0.42. Regressions of sire EBV on birth year were near zero ($P < 0.0001$) but in favorable directions for all breeds and traits. Genetic correlations of persistency of M, F, and P with SCS were moderate and negative for all breeds, indicating that persistency of SCS decreases as persistency of yield increases. Genetic correlations among yield and persistency were low to moderate and ranged from 0.01 (SCS) to 0.08 (F). As expected, selection for improved yield has not affected persistency of yield. Heritabilities and repeatabilities were similar to those previously reported for US Holsteins with the exception of SCS, which were larger in the colored breeds.

Table 1. Heritabilities, repeatabilities, and genetic and phenotypic correlations among persistency traits in Brown Swiss.

Trait	M[1]	F	P	S
M	**0.10 (0.19)**	0.84	0.88	-0.52
F	0.76	**0.08 (0.17)**	0.80	-0.50
P	0.91	0.79	**0.08 (0.17)**	-0.44
S	-0.21	-0.15	-0.17	**0.06 (0.12)**

[1]Heritabilities (repeatabilities) on diagonal, genetic correlations above diagonal, and phenotypic correlations below the diagonal.

Key Words: Best Prediction, Persistency, Test Day Model

M53 Phenotypic and genetic analysis of days open for Japanese Holstein cows. H. Abe*, M. Suzuki, and Y. Masuda, *Obihiro University of A & VM.*, *Obihiro, Japan*.

The objectives of this study were to analyze phenotypic change and to estimate genetic parameters of days open for Japanese Holstein cows. Days open for cows that calved between 1990 and 2002 were calculated from reproduction records obtained from Hokkaido Dairy Milk Recording & Testing Association. Phenotypic change of records from first to fifth parities was investigated. Descriptive statistics were calculated by categories of herd size and average yield of herd. Days open of first and second parities were analyzed by a two-trait animal model. The model included the fixed effects of herd-year, month of calving and age of calving, and random additive genetic effect of animal. The numbers of records were 592,294 and 494,944 for the first and second parities, respectively. Records with less than 22 d or greater than 500 d were deleted. At least 5 records were required per herd-year. The numbers of edited records were 338,440 and 249,702 for the first and second parities, respectively. Five subsets of records were extracted by random sampling of herds, and means of estimates on each subset were used as final estimates. Genetic parameters were estimated by the AIREMLF90 program. The mode on days open was nearly 75 d for each year. However, over the years, the average increased from 120 d to nearly 140 d. For all the categories of the herd size and average yield of herd, the modes were nearly constant, whereas the averages and standard deviations increased every year. As the average yield of herd increased, the averages and standard deviations for days open decreased. Moreover, as the herd size increased, the averages, standard deviations, and modes decreased. Estimates of heritability were 0.056 and 0.049 for the first and second parities, respectively. Estimates of phenotypic, genetic and environmental correlation were 0.11, 0.93 and 0.062, respectively.

Key Words: Days Open, Genetic Parameters, Japanese Holstein Cows

M54 Performance and egg quality of four quail genetic groups. C. Móri[1], E. A. Garcia[1], A. C. Pavan[1], C. C. Pizzolante[2], R. M. S. Emediato*[1], S. A. Maestá[1], and D. A. Berto[1], [1]*São Paulo State University*, *Botucatu, São Paulo, Brazil*, [2]*São Paulo Agency of Agribusiness Tecnology*, *Brotas, São Paulo, Brazil*.

The study aimed to evaluate the performance and egg quality of four genetic groups selected for meat production. Two hundred and eighty eight quails of 42 days of age were used. The experiment design was the completely randomized blocks with four treatments (genetic groups A, B, C and D) and six replications of 12 birds each. In the first week it was given 14 hour of light with increases of 30 minutes per week until it reaches 17 hours of light. Eggs and feed were weighted once a week to determine egg weight and feed consumption. Three eggs from each replication were collected and analyzed after each 28 days period during 3 consecutive days to evaluate their quality. There were significant differences ($p<.05$) among the genetic groups for egg weight and egg mass with higher values for the genetic group B. Treatment D has shown higher means for specific gravity and shell percentage. Quails used for meat production have shown as good for egg production with good quality of eggs.

Key Words: Egg Production, Meat Quail, Performance

M55 Relationship between calpastatin activity and lamb carcass characteristics. J. A. Gevin*[1], H. N. Zerby[1], P. S. Kuber[1], S. J. Moeller[1], M. P. Wick[1], D. R. Notter[2], T. D. Leeds[3], and M. R. Mousel[3], [1]*The Ohio State University*, *Columbus*, [2]*Virgina Polytechnic Institute and State University*, *Blacksburg*, [3]*USDA-ARS, U.S. Sheep Experiment Station*, *Dubois, ID*.

The purpose of this study was to determine if calpastatin activity (CALP) was related to the amount of intramuscular fat (IMF) and Warner-Bratzler shear force (WBS) in lamb carcasses. Market wethers representing three sire lines (n = 40, average live weight of 68.9 kg) were harvested at the OSU Meat Science Laboratory. *Longissimus thorasis* (L) samples were taken 24 h postmortem (PM) for determination of CALP and IMF (Caviezel® method). Standard carcass measurements were collected to assess relationships among traits. Nine (2.5 cm) chops were removed from the L at approximately the 7th through the 12th rib location, utilizing both the left and right side of the rack. Chops were randomly assigned to one of three (24 h, 72 h, and 7 d PM) aging periods and WBS was measured. Correlations between CALP, IMF, WBS and carcass traits were calculated. Using a mixed model with fixed sire line, aging and a sire line by aging interaction and a random animal within sire line effect, the force to shear samples decreased ($P < 0.01$) over time (24 h, 72 h and 7 d), with least squares means of 4.7 kg, 4.2 kg, and 2.7 kg, respectively. Percent intramuscular fat ranged from 2.9% to 8.5% with a mean of 5.8% (std. dev. 1.2%). Calpastatin was significantly ($P < 0.03$) and positively correlated with 24 h, 72 h, and 7 d WBS, $r = 0.35$, 0.40, and 0.40, respectively. Simple correlations of CALP with IMF ($r = -0.22$, $P = 0.17$), backfat ($r = -0.07$, $P = 0.68$) and body wall ($r = .0002$, $P = 0.99$) were not significant. Furthermore, IMF was not significantly correlated with 24 h ($r = 0.08$, $P = 0.63$), 72 h ($r = 0.13$, $P = 0.41$), or 7 d ($r = 0.06$, $P = 0.72$) WBS. These results are consistent with previous literature in lamb and beef reporting that CALP is positively correlated with WBS and in beef that IMF is not directly related to WBS. The correlation between CALP and IMF warrants further investigation.

Key Words: Calpastatin, Lamb, Intramuscular Fat

M56 Effect of salt, trisodium phosphate, BHA/BHT and CLA on sensory, quality and instrumental color characteristics of beef strip loins of different quality grades. C. W. Rowe*, F. W. Pohlman, A. H. Brown, Jr., and Z. B. Johnson, *University of Arkansas*, *Fayetteville*.

USDA Select and Choice (n=22) striploins were enhanced with trisodium phosphate in combination with salt, BHA/BHT and CLA to determine the impact of sensory and quality attributes. There were 10 Choice and 12 Select striploins used and analyzed in an oneway ANOVA. Treatments were: Choice control (n=5) (non-inject) (CC), Choice inject (n=5) (0.4% trisodium phosphate, 0.5% salt and 0.006% BHA/BHT) (CI), Select inject (n=4) (0.4% trisodium phosphate, 0.5% salt and 0.006% BHA/BHT) (SI), Select inject + CLA (n=4) (0.4% trisodium phosphate, 0.5% salt, 1.3% CLA and 0.006% BHA/BHT) (CL), and a Select control (n=4) (non-inject) (SC). All injected treatments were injected to 110% of their original weight. Injected treatments allowed for lower ($P < 0.05$) WBS, cooking loss, and lower retail purge. Injected treatments also allowed for greater ($P < 0.05$) myofibrillar and overall tenderness values, and lower ($P < 0.05$) connective tissue values when sampled by trained panelist. The injected treatments were also juicer ($P < 0.05$) than the two controls. There was a general decline during retail display for all of the instrumental color measures except for hue angle which had a general increase in value. There were no treatment differences ($P > 0.05$) in regards to b*, a*, hue angle, and saturation index. There were differences however in L* values where CL had the highest mean and was different ($P < 0.05$) from CI and SI. Treatment CL was not different ($P > 0.05$) from any of the other treatments for 630/580 nm, however, SI and CI did not differ ($P > 0.05$), but both were different ($P < 0.05$) from CC and SC. Marbling scores differed among the treatments with CC, SC, and SI not differing ($P > 0.05$) and CI and CC not differing ($P > 0.05$). However, CL differed ($P < 0.05$) from all other treatments having a higher score due to the CLA adding artificial marbling. This data suggest that through enhancement, overall palatability and marbling scores can be improved.

Key Words: Beef, CLA, Sensory

M57 Predicting beef tenderness using proteomic analysis of 36 hour postmortem muscle. M. S. Updike*, I. Zapata, H. Zerby, and M. Wick, *The Ohio State University*, *Columbus*.

Inconsistency in tenderness has been described as the biggest factor negatively impacting beef palatability, significantly harming the beef industry. Currently, carcasses are sorted into palatability classes using quality grade, a score based on physiological age and intramuscular fat, which is slightly correlated to tenderness. A method that would rapidly and accurately predict tenderness would be an advantage to the beef industry. The long term goal of our laboratory is to create an immunochemical test strip which can accurately predict tenderness for consumers (7-14 d postmortem) when the carcasses move from the cooler for fabrication (24-48 h postmortem). Previous research from our lab used bovine myofibrils from 36 h to predict 7 d tenderness as proof of principle. To expand upon that research, 34 Angus cross steers were harvested at The Ohio State University meat lab. Samples of Longissimus dorsi were taken at 36 h postmortem for proteomic analysis and sarcomere length determination. Steaks were assayed for tenderness using Warner Bratzler sheer (WBS) force at 7 and 14 d

postmortem. Sarcomere length determination samples were dissected and fixed in a glutaraldehyde/cacodylic acid buffer. Samples were homogenized in cacodylic acid buffer, mounted on glass slides, observed by phase contrast microscopy and images captured with a CCD camera. Proteomic analysis samples underwent principle component fractionation using a high salt extraction. Both the high salt soluble fraction and the high salt insoluble fraction were solublized and run on SDS-PAGE using 5-20% gradient polyacrylamide gels. The resulting images were analyzed and the percent that each band contributed to the total was used in a reverse step wise regression on the WBS force value and on the sarcomere length. Ten bands from 36 h samples were identified that are associated with and predictive of 7 and/or 14 d tenderness ($r^2 = 0.76$, $p \leq 0.01$). Five bands were identified that are associated with the sarcomere length ($r^2 = 0.66$, $p \leq 0.01$). These results suggest that an immunochemical test strip could accurately predict tenderness of beef when it is consumed at 7 to 14 d postmortem.

Key Words: Beef, Tenderness, Proteomics

M58 Evaluation of different fatty acid methyl ester preparation procedures for analysis of egg fat with emphasis on omega-3, omega-6 and conjugated linoleic acids. G. Cherian*, A. S. Abd El-Hakim, and M. P. Goeger, *Oregon State University*, *Corvallis*.

With the availability of different brands of fatty acid modified eggs on the market, accurate methods to measure fatty acid content in eggs is needed. Fatty acids are usually analyzed as their methyl esters (FAME). In the current study, three different FAME preparation procedures were compared using regular, omega-3, or conjugated linoleic acid (CLA)-enriched eggs. Lipids from egg yolk were extracted with chloroform:methanol (2:1) and an aliquot (0.5 ml) dried under N2 at 40C. In Method 1, methanolic HCl (1 ml) was added to the lipid extract and heated at 60C for 40 min. In Method 2, hexane (2 ml), methyl acetate (0.04 ml) and methylating reagent (0.04 ml) [1.75ml methanol, 0.4 ml sodium methoxide (5.4 mol/L)] were added to the lipid extract, allowed to stand 10 min at room temperature then combined with stopping reagent (0.06 ml) [0.1g oxalic acid in 3.0 ml diethyl ether] and centrifuged at 2400 × g for 5 min. In Method 3, lipid extract and methylating reagent (2 ml) [45% methanol, 35% boron trifluoride, 20% hexane] were heated at 90-100C for 60 min. FAME was extracted with distilled water and hexane. An internal standard (C19:0) was used for quantification. Highest recovery of alpha-linolenic acid (18:3n-3), linoleic (18:2n-6), cis9, trans11 and trans10, cis12 CLA was obtained with Method 3 ($P<0.05$). No difference was found in the docosahexaenoic acid (DHA, 22:6n-3) content of regular eggs with the three methods tested. Recovery of DHA for omega-3 eggs was best with Method 3 ($P<0.05$). Lowest recovery of DHA for CLA-enriched eggs was obtained with Method 1 ($P<0.05$). The current study shows that FAME preparation methods should be based on the egg type and the experimental objectives.

Key Words: Egg, Fatty Acid Methyl Ester, Omega-3

M59 Effect of animal, transportation, and slaughterhouse variables on beef behavior at the slaughterhouse. N. Mach*[1], A. Bach[2,1], A. Velarde[3], and M. Devant[1], [1]*IRTA*, *Barcelona, Spain*, [2]*ICREA*, *Barcelona, Spain*, [3]*IRTA*, *Girona, Spain*.

To evaluate the influence of factors related to animal, transportation and animal handling at the slaughterhouse, as well as their interactions, on behavior of beef cattle at the slaughterhouse, a total of 1,633 beef cattle were monitored. A scan sampling of 182 pens (9.13 ± 3.94 animals/pen) with a 30-min interval was conducted 3 times per pen, to study the lying, drinking, exploring, and ruminating behaviors. Mounting behavior was registered continuously during 15 min. A Poisson regression model was conducted with 5 variables to identify the main factors, and their interactions, affecting the incidence of each studied behavior at the slaughterhouse. Lying, drinking, exploring behaviors were not affected by the factors studied, and no statistical interactions were observed. Average incidence of animal mountings and ruminating behavior were 0.9 ± 0.12, and 0.66 ± 0.04 cases per pen, respectively. The incidence rate ratio (IRR) of mountings was 4.54 times greater ($P < 0.001$) in males than in females. Furthermore, the IRR of mountings was 1.28 times greater ($P < 0.01$) in medium (0.19 to 0.35 animal per m^2) and 0.57 times lower in high (≥ 0.27 animal per m^2) than in the low (≤ 0.19 animal per m^2) stocking densities at slaughterhouse. In contrast, ruminating behavior was greater ($P < 0.001$) in females than in males (IRR = 1.68), and slightly decreased ($P < 0.05$) as waiting time at the slaughterhouse increased from 4 to above 12 h (IRR = 0.66), being reduced 34% when animals waited over 12 h at slaughterhouse. Handling decisions such as optimizing stocking densities and waiting time at the slaughterhouse may reduce the incidence of mountings and improve rumination time. Additionally, both behaviors were affected by gender.

Key Words: Beef, Behavior, Pre-slaughter Handling

M60 Effects of dietary vitamin A on growth and beef quality traits of Limousin × Chinese Luxi steers. J. Q. Wang*, F. C. Wan, D. P. Bu, H. Y. Wei, and L. Y. Zhou, *State Key Laboratory of Animal Nutrition, Institute of Animal Science, Chinese Academy of Agricultural Sciences*, *Beijing, China*.

Thirty two (11±0.5mo; 310±10.35 kg) Limousin × Chinese Luxi steers were allotted to one of four dietary treatments(n=4) in two trials with a randomized complete design to evaluate the effects of supplementation of vitamin A on growth, carcass trait, beef quality and chemical composition. Steers were fed a basal diet supplemented with 0 (A0),1100 (A1100), 2200 (A2200), or 4400 IU (A4400) of vitamin A (palmitate retinyl ester, IU /kg DM) for 90d(Exp 1) or 180d(Exp 2). At the end of finishing , 3 steers of each treatment were transported to a commercial slaughter facility. HCW(Hot carcasses weight) were measured and marbling scores(MS) were recorded according to JMGA grading system. Samples of longissmus muscle(LM) were taken at 7-12 ribs of each right side carcass and water holding capacity(WHC) was measured. Warner-Bratzler shear force(WBSF) was evaluated using 7- to 8-cm thick steaks. Chemical composition of intramuscular fat, moisture, protein, and ash of LM were determined according official methods. Lipid oxidation determined as thiobarbituric acid-reacting substances (TBA).HP (heme pigment) and DL (drip loss) of steaks were measured at 168h of aging period. No treatment difference($p>0.05$) were observed for dry matter intake(DMI),average daily gain(ADG),feed gain ratio (F/G) and chemical compositions of LM. MS for carcass in Exp 2 were 6.00^{ab},$7,33^{a}$,5.00^{b} and 5.67^{b}in A0,A1100,A 2200 and A 4400($p=0.04$) respectively.Decreased dietary vitamin A concentration improved the drip loss (DL), antioxidant ability of the fat and water holding capacity(WHC) in Exp 1. However, dietary VA level had no apparent effect($p>0.05$) on most meat quality traits.

Table 1.

Item	A0	A1100	A2200	A4400	SEM	p
Exp 1						
TBA168*	0.53	0.51	0.63	0.84	0.091	0.11
HP168*	13.17	15.40	13.76	13.58	1.10	0.53
WBSF,kg	7.96	6.87	6.25	8.81	1.17	0.28
WHC,%	19.77[b]	27.18[a]	25.77[a]	25.78[a]	1.49	0.03
HCW,kg	184	184	192	194	7.88	0.74
Exp 2						
TBA168*	0.87	0.75	0.65	0.72	0.13	0.65
HP168*	12.76	12.57	11.90	14.78	1.47	0.57
WBSF,kg	7.36	5.88	5.62	9.36	1.31	0.24
WHC,%	26.77	24.32	26.87	27.42	2.04	0.57
HCW,kg	211	224	214	206	7.86	0.47

*mg/100g.[abc]Means within a row with unlike superscripts differ(P<0.05)

Key Words: Vitamin A, Beef Quality Traits, Chinese Luxi Cattle

M61 Effects of supplemental fat on growth performance and quality of beef from steers fed corn finishing diets. M. L. Nelson*, J. R. Busboom, C. F. Ross, and J. V. O'Fallon, *Washington State University*, *Pullman*.

To measure effects of dietary fat on feedlot performance, carcass characteristics, and beef appearance, moisture binding, shelf life, palatability and fatty acid content, 126 crossbred beef steers (321.1 ± 0.57 kg) were allotted to a randomized complete block design with a 3 × 2 + 1 factorial arrangement of dietary treatments. Main effects were level of yellow grease (0, 3 or 6%) and alfalfa hay (3.5 or 7%) in corn-based diets containing 15% potato byproduct (PB). The added treatment was 6% tallow and 7% alfalfa in a barley-based diet containing 15% PB. Dry matter intake and ADG were not affected by diet, however G/F and diet NE content increased linearly ($P \leq 0.10$) as yellow grease increased. Kidney, pelvic, and heart fat (2.0 to 2.3 ± 0.07) and yield grade (2.8 to 3.1 ± 0.09) increased linearly ($P \leq 0.05$) as yellow grease increased. Yellow grease fed steers had lower ($P \leq 0.05$) beef firmness and beef texture scores but greater ($P \leq 0.01$) fat color score than those fed tallow. Moisture retention of beef was not affected by dietary treatment except purge score during retail storage was decreased linearly ($P \leq 0.01$) 2.1 to 1.6 ± 0.06 by level of yellow grease. Steaks from barley plus tallow fed steers had greater ($P \leq 0.05$) shear force than those from steers fed corn plus yellow grease. But beef flavor increased linearly ($P \leq 0.05$) from 6.2 to 6.7 ± 0.11 as yellow grease increased. Level of yellow grease decreased linearly ($P \leq 0.01$) vaccenic acid but increased linearly ($P \leq 0.01$) transvaccenic acid (TVA) and CLA content of beef. Beef from corn plus yellow grease-fed steers had lower ($P \leq 0.05$) palmitoleic and oleic acids and greater ($P \leq 0.05$) linoleic, TVA, and CLA than beef from barley-tallow fed steers. Feeding yellow grease increased diet energy content which increased carcass fatness, altered beef fatty acid content which increased beef flavor without affecting moisture retention, shelf-life, or cooking properties of the beef. Additionally, beef from corn plus yellow grease-fed steers was more tender and had more unsaturated fatty acid content and CLA than of beef from barley plus tallow-fed steers.

Key Words: Beef Cattle, Yellow Grease, Fatty Acid

M62 Influence of β-adrenergic agonist (Metaproterenol) and lysine on growth, carcass quality in broiler chickens. A. M. Tahmasbi*[1], E. Kasefi[2], G. Moghadam[2], A. Taghizadeh[2], and H. A. Ghasemi[2], [1]*University of Mashhad*, *Iran*, [2]*University of Tabriz*, *Iran*.

An investigation was made to find out the importance of β-adnergenic and lysine on carcass characteristics and blood metabolite of 648 broiler chickens from 21–42 days of age. Effect of metaproterenol (a β2- adrenergic agonist) and lysine were assessed by mixing them in feed at 0.0, 0.25, 0.50 and 1.00 ppm metaproterenol sulfate and 100%, 115% and 130% of NRC recommended lysine in a 4–3 factorial arrangement of treatments. Chickens were reared under normal condition to 3 week of ages and then randomly allocated to treatments. Each treatment contained 3 pens with 18 birds/pen. Body weight gains (BWG), feed conversion ratio (FCR) abdominal fat pat (AFP) breast weight (BW) were measured. Result indicate that during 4th and 5th week of study using metaproterenol (0.5 ppm), compare to control group, improved BWG (5.1%), carcass efficiency (3.4%) and breast weight (2.2%), breast and thigh muscle protein and depressed abdominal fat (P<0.05). Increasing lysine levels lead to significant increase in body weight gain, carcass weight, carcass efficiency, breast muscle weight (P<0.5), but it has no effect on feed intake, feed conversion ratio, blood metabolites. Data from this experiment suggested that both adding 0.5 ppm β-adrenergic agonist metaproterenol sulphate significantly improved birds performance and their carcass quality and the most efficient lysine level for broiler chickens was proved to be 115% NRC recommended.

Key Words: Broiler, Adrenergic Agonis, Carcass Composition

M63 Effect of deboning time and muscle type on dielectric properties of uncooked chicken breast meat at 5°C. H. Zhuang*, S. Nelson, S. Trabelsi, and E. Savage, *Agriculture Research Service, USDA*, *Athens, GA*.

Color, pH, water-holding capacity and texture (or tenderness) are the most commonly-used quality indicators for chicken meat, and they can be significantly affected by deboning time and muscle type. So far, little attempt has been made to assess and monitor these quality indicators during processing at a refrigerated temperature by using rapid and non-destructive instrumental methods. Dielectric properties measurements have potential to assess raw meat quality nondestructively. The objective of this study was to determine the effects of muscle type and deboning time on dielectric properties of uncooked chicken breast meat at 5°C. The dielectric properties, consisting of the dielectric constant and loss factor, were measured with an open-ended coaxial-line probe and impedance analyzer for uncooked chicken breast muscle Pectoralis major and Pectoralis minor, deboned at 2- and 24-h postmortem, at frequencies of 10, 26, 900 and 1800 MHz and 5°C. The quality indicators were also measured. Our study shows that there are no differences in the dielectric constant and loss factor values for the two deboning times or for the two muscle types. However, the deboning time significantly ($p < 0.1$) affects the average values of the loss tangent (dielectric loss factor/dielectric constant) at frequencies 26, 900 and 1800 MHz, and the muscle type significantly ($p < 0.1$) affects the loss tangent at 900 MHz. The deboning time and/or muscle type have also significant effects ($p < 0.05$) on the quality indicators, color (L* value), pH, water-holding capacity, drip loss, and texture (Warner-Bratzler shear force value). These results suggest that there is a potential for using dielectric

properties measurements, or specifically the loss tangent, to assess the quality, deboning time, and/or muscle types of chicken meat at a refrigerated temperature during the processing. Further studies are needed to determine the relationships between dielectric property measurements and the quality indicators, deboning time and muscle types.

Key Words: Chicken Breast Muscle, Dielectric Property, Deboning

M64 Rabbit meat quality as affected by feed containing coconut meal. D. V. Souza[1], J. F. F. Zapata*[1], E. R. Freitas[1], D. S. Garruti[2], E. M. C. Silva[1], T. F. Vidal[1], and A. L. F. Pereira[1], [1]*Universidade Federal do Ceará*, *Fortaleza, CE, Brasil*, [2]*Embrapa Agroindústria Tropical*, *Fortaleza, CE, Brasil*.

The objective of this work was to assess the effect of feeding rabbits (White New Zeeland × Californian) with diets containing coconut meal (CM) on meat proximal composition (moisture, protein, fat and ashes), pH, color (components L*, a* and b*), water holding capacity (WHC), cooking losses (CL), shear force (SF) and fatty acid profile. The experiment utilized 60 rabbits in a complete randomized design with diets containing five levels of CM: 0% (control diet), 6.25, 12.5, 18.75 and 25.00%) and 12 animals per treatment. Increasing levels of CM in the diet did not affect ($p \geq 0.05$) meat proximal composition, pH or CL, but it showed a quadratic effect on meat WHC and a linear effect on meat SF. Diets containing 25.00% CM produced meat with lower ($p \leq 0.05$) WHC and those containing 18.75 and 25.00% CM produced meat with higher ($p \leq 0.05$) SF than that from the control diet. Meat color component a* in meat from diets containing 12.5, 18.75 and 25.00% CM was higher ($p \leq 0.05$) than that from the control diet. Meat color component b* was linearly affected by CM levels and all diets containing CM produced meats with higher ($p \leq 0.05$) b* values than that from the control diet. The levels of palmitoleic, stearic, and linolenic acids in the meat were linearly affected by CM levels in the diets. When compared to the levels of fatty acids in the meat from the control diet, palmitic acid was lower ($p \leq 0.05$) in the meat from all diets containing CM; myristic acid and stearic acid levels were higher ($p \leq 0.05$) and palmitoleic acid level was lower ($p \leq 0.05$) in the meat from the diet containing 25.00% CM; and linolenic acid level was lower ($p \leq 0.05$) in meats from diets containing 18.75 and 25.00%. The relation P/S in the meat decreased ($p \leq 0.05$) when rabbits were fed the 18.75 and 25.00% CM diets suggesting that these levels of inclusion increase the saturated fatty acid content in rabbit meat.

Key Words: Fatty Acids, Shear Force, Water Holding Capacity

M65 Fatty acid profile of *Longissimus* by steers finishing at *Brachiaria brizantha* cv. Stapf. pasture, under tropical conditions. D. M. Lambertucci*[1], R. H. T. Buschinelli de Goes[2], A. B. Mancio[1], C. Mistura[3], and R. P Lana[1], [1]*Universidade Federal de Viçosa*, *Viçosa, Minas Gerais, Brasil*, [2]*Universidade Federal da Grande Dourados*, *Dourados, Mato Grosso do Sul, Brasil*, [3]*Universidade do Estado da Bahia*, *Juazeiro, Bahia, Brasil*.

The chemical composition and the fatty acids profile of *Longissimus* muscle of Nellore steers (NL) and its crossbreeds with Simental (SI) and Santa Gertrudis (SG) finished in pastures of *Brachiaria brizantha* cv Stapf, were evaluated. They were studied 14 animals carcasses, with live weight of 481+30 kg, receiving 1.1 kg of supplement/day, containing 24% of CP. Among to 12nd and 13rd rib, a sample of the *Longissimus* muscle was removed. The pasture of *Brachiaria brizantha* presented low tenor of saturated fatty acids (29.69%), high tenor of omega 3 acid (28.21%). The crossbreed with Santa Gertrudis presented smaller saturated fatty acid tenor (SFA), of (45.47%), if compared with Nellore and Simental, 48.15 and 47.96%, respectively. The tenors of the linoleic conjugated acid (CLA) and omega-3 acid (mg/100g muscle) were higher in Nellore steers, presenting values of 1.27% of CLA and 2.09% of omega-3 acid, while the animals Santa Gertrudis and Simental presented values of 1.03 and 1.16% of CLA and 1.81 and 1.56% of omega-3 acid, respectively. There was no difference among the genetic groups for the polyunsaturated acids (PUFA) and monounsaturated acid (MUFA), as well as for the omega-6 acid. The average for the PUFA was of 7.7%. The average of the tenor of observed SFA was of 47.19%, and the relationship among PUFA/SFA was of 0.16. The total CLA was significant ($P < 0.05$) for the Santa Gertrudis steers (64.22%) in relation to the Simental (46.69%) and Nellore steers (41.68%). The linoleic conjugated acid (18:2 c-9, t-11; 18:2 c-11, t-13 and 18:2 t-10, c-12) followed a similar behavior, being verified the CLA 18:2 c-9, t-11 for samples of muscle of the Santa Gertrudis steers were 61.92% higher to Nellore steers; for the CLA 18:2 c-11, t-13, the difference was of 56.32%; and for the CLA 18:2 t-10, c-12 the difference was of 52.11%.

Key Words: Linoleic Conjugated Acid, Fatty Acids, Genetic Group

M66 Phenotypic correlation of egg weight and egg morphometric measures. O. T. F. Abanikannda[1], A. O. Leigh[1], O. Olutogun[2], L. A. Ajayi*[1], and M. Orunmuyi[3], [1]*Lagos State University*, *Ojo, Lagos State, Nigeria*, [2]*University of Ibadan*, *Oyo State, Nigeria*, [3]*Ahmadu Bello University*, *Zaria, Kaduna State, Nigeria*.

Weight and morphometric measurements were taken on table eggs from Harco heavy breed layers in the humid tropics of Lagos, Nigeria. Statistical descriptive measures and relationships between egg weight (EGGWT), egg length (EGGLT), egg width (EGGWD) and egg shape index (SHPINDX) were studied. A total of 2951 eggs were obtained from layers at five different age groups in lay. The descriptive statistics are presented in the table below. Egg weight and egg width exhibited similar pattern in their distribution across the different age groups, with steady increase from age group A (22 - 32 weeks), peaked at age group D (55 - 65 weeks) before a decline afterwards. Egg length consistently increased with increasing age of hen, while shape index consistently decreased with increasing age of hen. Correlation between egg weight & egg length, egg width and shape index was 0.78, 0.84 and -0.07 respectively, while the correlation between egg length & egg width and shape index was 0.53 and -0.60 respectively, and between egg width and shape index was 0.37. The fitted model of the study was EGGWT = -124.72 + 1.65EGGLT + 1.32EGGWD + 0.43SHPINDX. All coefficients obtained were significant ($P<0.05$), however, it was observed that egg length and egg width were better predictors of egg weight when compared to shape index. Analysis of variance revealed that effects of all factors studied (age group, egg length, egg width, shape index and egg length × egg width interaction) were highly significant ($P<0.01$) on egg weight except for shape index which was significant ($P<0.05$). A further separation of the means for all the variables studied across the five age groups was done using Tukey's method. Morphometric measures studied were good predictors of egg weight.

Table 1. Mean ± S.E. of the Correlates Studied Across Age Groups

Age Group (Weeks)	N	Egg weight (g)	Egg length (mm)	Egg width (mm)	Shape Index (%)
A (22–32)	596	49.94±0.20^{c}	53.86±0.09^{d}	40.91±0.06^{d}	76.02±0.12^{a}
B (33–43)	599	56.35±0.18^{b}	56.17±0.09^{c}	42.53±0.05^{c}	75.79±0.12^{ab}
C (44–54)	564	75.79±0.12^{b}	56.65±0.11^{b}	42.77±0.07^{bc}	75.58±0.13^{ab}
D (55–65)	596	58.63±0.23^{a}	57.27±0.11^{a}	43.16±0.08^{a}	75.47±0.16^{b}
E (66–76)	596	58.05±0.19^{a}	57.43±0.10^{a}	42.90±0.05^{b}	74.81±0.13^{c}
Combined	2951	55.99±0.11	56.27±0.04	42.45±0.03	75.53±0.06

Key Words: Shape Index, Morphometric Measures, Egg

M67 Effect of vitamin D_3supplementation on plasma and muscle calcium levels, tenderness and sensory characteristics of crossbred grazing steers in the tropics. J. Gutierrez, L. Machado, O. E. Moron-Fuenmayor, O. E. Araujo-Febres*, and S. Pietrosemoli, *La Universidad del Zulia*, *Maracaibo, Estado Zulia, Venezuela*.

Sixty large framed, *Indicus* × *Continental*, crossbred beef steers grazing in a tropical dry forest environment, were used to investigate the effect of supplementing diets with various levels of vitamin D_3 (VITD) to provide 0, 6, and 10 million IU/(steer×d) for 8 d before slaughter on plasma (PCa) and *Longissimus lumborum* muscle Ca^{2+} (MCa) concentrations, texture analysis (TX), and sensorial analysis of the organoleptic qualities, in which appearance (A), odor (O), flavor (F), juiciness (J), amount of connective tissue (CT), and tenderness (T). Steers were slaughtered using an approved humane technique. A randomly subsample of five steers of the three individual VITD treatments (n = 15) was chosen for meat quality and palatability analyses. Following a 24-h chilling period -4°C, carcasses (a randomly selected subsample n=15) were ribbed, one strip loin of *Longissimus lumborum* (LL) muscle was removed from each carcass. Steaks were vacuum-packed. The data were analyzed in a completely randomized design using the General Linear Models procedures. Warner-Bratzler shear force (WB) was measured on strip loin at 7 d postmortem. Steaks for WB and sensory evaluation were thawed to 2°C. Blood plasma Ca^{2+} and muscle Ca concentration of cattle treated with VITD were higher ($P < .05$) than controls. VITD supplementation did not ($P > .05$) affect TX. Sensory traits of appearance, odor, flavor, juiciness, connective tissue, and tenderness were improved ($P < .05$) by all VITD treatments in LL steaks. Treatment with VITD will effectively improve tenderness in grazing zebu cattle in tropical conditions.

Key Words: Beef, Vitamin D, Tenderness

M68 Evaluation of freshness of egg yolks and shell eggs stored under the super chilled temperature through analyses of changes of volatiles and lipoprotein conformation. T. Yanagisawa*[1], C. Watanuki[1], M. Ariizumi[1], Y. Shigematsu[1], H. Kobayashi[1], M. Hasegawa[1], and K. Watanabe[2], [1]*Q.P. Corporation*, *Tokyo, Japan*, [2]*Tokyo University of Agriculture*, *Kanagawa, Japan*.

This study evaluated freshness of egg yolks and shell eggs stored under the super chilled temperature range (-5-0°C) by analyzing changes in volatiles affecting their flavors and lipoprotein conformation affecting their emulsifying characteristics. As the samples, 10% salted egg yolks were stored at -30, -20, -15, -5 and 5°C, and shell eggs were stored at 0, 10, 20°C with different carbon dioxide concentrations in packages. To analyze volatiles, those samples were incubated and generated headspace gas was absorbed on solid phase microextraction (SPME) fiber and obtained volatiles were analyzed using gas chromatography-mass spectrometry (GC-MS). The analyses demonstrated that amount of volatiles such as hexanal considered to generate by lipids oxidation was the smallest in the samples stored at the super chilled temperatures for both salted egg yolks (-5 and 5°C) and shell eggs. Generation of volatiles in shell eggs was also suppressed at higher carbon dioxide levels. For salted egg yolk samples, conformational changes of lipoproteins were observed using ^{31}P nuclear magnetic resonance (NMR) spectroscopy, as the changes of peaks of phosphorus atoms of phospholipids in the lipoproteins. The alterations of the peaks of the super chilled egg yolks were smaller than those of egg yolks stored at the lower temperatures. The results suggested that there are less conformational changes of lipoproteins at the super chilled temperature (-5°C). It has been also confirmed that the shell egg samples stored at the super chilled temperature range maintained high freshness from the Haugh Unit values and the pH values of their egg white. This study demonstrated effectiveness of super chilling storage for maintaining freshness of salted egg yolks and shell eggs by new analytical methods.

Key Words: Egg, Super Chilling Storage, Freshness

Extension Education - Livestock and Poultry

M69 StockPlan: Decision support tools for exploring management options for drought. M. J. McPhee*[1], G. Meaker[1], P. M. Graham[1], B. L. Davies[1], and M. B. Whelan[2], [1]*NSW DPI*, *Armidale, Australia*, [2]*Southern Cross University*, *Lismore, NSW, Australia*.

StockPlan® is a suite of activities that can be undertaken during workshops and subsequently at home. It is highly recommended that StockPlan® is taken as a workshop. The StockPlan® resources include: StockPlan® Basics-Producer Manual; StockPlan® Extras – Home Study Guide; the Resources CD; StockPlan® CD and the StockPlan® User Manual. This study describes the 3 StockPlan® decision support tools (DST; Drought Pack, Feed Sell Agist (FSA) Pack, and ImPack) that include the StockPlan® User Manual to assist producers and extension staff test out management strategies for sheep or cattle through a projected period of limited pasture or drought. **Drought Pack** can help producers or extension staff choose between different strategies when faced with a period of limited or severely reduced pasture supply. The DST assesses the likely financial consequences of various strategies and looks at the impact of each strategy by varying the length of time that pasture may be limited. The DST also estimates the likely cost to repurchase stock when the drought ends. **FSA Pack**

is designed to assist producers or extension staff select the best option: to feed, sell, or agist. FSA also provides the user with the opportunity to calculate the expected costs of each option available based on the probability of each event occurring. **ImPack** is designed to assist the producer or extension staff test breeding, selling, and buying strategies for any beef breeding herd or sheep flock. ImPack will evaluate what will happen to the herd or flock age structure, animal production, and cash flow on an annual basis over an 11-year period. The models implemented in ImPack were developed to explore the consequences of a drought-forced reduction. The DST can also cater for other management changes e.g., flock reductions due to disease. The ImPack models are designed to represent a year where flock or herd numbers are reducing followed by a recovery period over the next ten years. ImPack also illustrates the long-term consequences of a one-year herd or flock reduction. Drought Pack, FSA Pack, and ImPack are valuable management tools that can be used for drought risk management plans.

Key Words: Drought, Management, Risk

M70 Characterization of claw lesions associated with lameness in the University of Arkansas sow herd. C. L. Bradley*[1], J. W. Frank[1], C. V. Maxwell[1], Z. B. Johnson[1], J. G. Powell[1], S. R. Van Amstel[2], and T. L. Ward[3], [1]*University of Arkansas*, *Fayetteville*, [2]*University of Tennessee*, *Knoxville*, [3]*Zinpro, Inc.*, *Eden Prairie, MN*.

Claw lesions that have been associated with lameness were evaluated for three successive breeding cycles in 201 multiparous sows (Monsanto Choice Genetics: GPK348, GPK348 × GPK4, and GPK35) to characterize lesion frequency. Each sow was evaluated in a modified calf table and flipped on her side, where both claws of each foot were evaluated by the same technician. The lesions evaluated were: heel erosions, Fischer's Cracks, excessive growth of the soft tissue, axial (inner) and abaxial (outer) white line cracks or separation on the sole, horizontal and vertical wall cracks, hardship grooves in the hoof wall, hemorrhages, and abscesses of the soft and hard tissue. Lesions were evaluated on a scale of 1 to 3, with 1 representing a mild lesion, 2 representing a moderate lesion, and 3 representing a severe lesion. Overall, greater than 95% of sows had at least one type of lesion during the study. Heel erosions (43.8%) were the most common type of lesion, followed by abaxial white line cracks (17.6%), Fischer's Cracks (11.0%), vertical wall cracks (8.6%), hemorrhages (6.5%), and axial cracks (5.2%), with the frequency of each of the remaining lesion types at less than 2.2% of total lesions. The rear outer claws had the largest occurrence of a noted lesion (49.3% of total lesions), followed by the front outer claws (26.1% of total lesions). Of all the lesions noted, 57.0% were scored a 1, 28.5% a 2, and 14.5% a 3. The likelihood of an axial white line crack, a Fischer's Crack, heel erosion, or hemorrhage was related to sow parity ($P < 0.05$). Within lesions identified as heel erosions, parity 1 sows had the highest frequency (25.0%), followed by parity 3 (14.8%), parity 5 or greater (13.0%), parity 4 (11.1%), parity 0 (8.3%), and parity 2 (8.4%; $P < 0.05$). The majority of lesions observed in this herd were mild, with heel erosions being the most predominant. Our data also indicate that the rear outer claws had the greatest number of lesions associated with lameness in sows.

Key Words: Sows, Lesions, Lameness

M71 Maryland dairy producer education needs assessment study. R. R. Peters*, K. M. Wilson, M. R. Bell, R. A. Erdman, S. W. Fultz, J. E. Hall, R. A. Kohn, W. D. Lantz, J. W. Semler, and M. A. Varner, *University of Maryland*, *College Park*.

The number of Maryland dairy farms has been steadily declining over the last several decades as many areas of the state have made a demographic shift from rural to suburban. To identify current demographics, practices and potential educational needs of dairy producers in Maryland, a 15-page questionnaire was constructed. The questionnaire was sent to a sample of 629 licensed dairies in Maryland using a multi-wave mail strategy with a response rate of 49%. The objectives of this study were 1) to determine what program topics are of current interest to dairy producers and 2) to identify their preferential media type and informational sources. Statistical analyses were conducted using SPSS software. The survey indicated that the responding dairy producers often have dairy-production related questions and are moderately to very interested in obtaining more information about such topics. The topic areas that most interested dairy producers include mastitis and milk quality, reproductive management, nutrition and feeding, and transition cow management. Topics of least interest primarily included recent technologies and non-conventional dairying methods. Dairy producers tended to utilize local sources of information including veterinarians, local farm/feed suppliers and other dairy producers in the area. The most valued characteristics in these sources included individuals that had general knowledge about many topics, had quick access to a specialist when needed, could provide a quick response and were willing to visit their farms. Producers most frequently obtained information from dairy and cattle/farm magazines, observations of other producers and county extension newsletters. Respondents also indicated that University of Maryland Extension, industry sponsored events, dairy organizational events, and regional dairy trade shows were most useful for providing educational information. The survey helped Cooperative Extension to identify topics, media type and information sources that dairy producers value most for future educational programming.

Key Words: Dairy, Needs Assessment, Survey

M72 Trends in Maryland dairying and future prospects. R. R. Peters*, K. M. Wilson, M. R. Bell, R. A. Erdman, S. W. Fultz, J. E. Hall, R. A. Kohn, W. D. Lantz, J. W. Semler, and M. A. Varner, *University of Maryland*, *College Park*.

Maryland's dairy industry faces the constraints of urban growth and reduced milk prices currently affecting the dairy industry nationwide. To identify potential educational needs, practices and demographics of dairy producers in Maryland, a 15-page questionnaire was constructed and sent to a sample of 629 licensed dairies in Maryland using a multi-wave mail strategy, with a response rate of 49%. The objective of this study was to identify characteristics of Maryland dairy operations including, 1) strategies for remaining competitive, 2) constraints of growing the dairy operation and 3) the projected outlook of dairy producers. Statistical analyses were conducted using SPSS software. Respondents indicated their role in the farm business as sole proprietor (64%), business partner (11.4%), renting (9.8%), corporation (9.8%) and other (4.9%). The average herd size was 108 cows with 84 replacements and calves. Respondents reported having predominantly Holstein (92%), Jersey (19%) and crossbred cattle (15.6%). Most survey respondents indicated they operated the following type of dairy: whole herd (72%); free stall (68%); and grade cattle (59%) with an

average of 124 hectares of tillable cropland. Non-conventional types of dairy included grazing (31%), value added (4%), agro-tourism (4%), and organic dairy (3%). Respondents indicated that business management practices including keeping cost of production, up-to-date business records, herd health records and accurate production records as their top priorities. The five most important limiting factors to improving and/or growing the dairy operation were land costs, low profits, encroachment of development, labor availability and government regulations. Ninety-four percent of all survey respondents plan to be in the dairy business in 5 years with an average herd size of 127 cows. Results of this study indicate that some dairy producers in Maryland have adapted to a changing economy with non-conventional operations. Nearly all producers plan to stay in dairying in the next 5 years with larger size herds.

Key Words: Dairy, Needs Assessment, Survey

M73 Field evaluation of laboratory assays to assess starch and fiber digestibility in corn grain and silage. M. D. Tassoul*[1], R. D. Shaver[1], J. A. Barmore[2], D. Taysom[3], and P. C. Hoffman[1], [1]*University of Wisconsin, Madison*, [2]*Five-Star Dairy Consulting LLC, Verona, WI*, [3]*Dairyland Laboratories, Inc., Arcadia, WI*.

Objectives of this field trial were to evaluate laboratory assays to assess starch digestibility in dry (DC) and high-moisture corn (HMC) and starch and fiber digestibility in corn silage (WPCS). Samples (n = 11, 16 and 29 for DC, HMC and WPCS replicate samples, respectively) were obtained from inventories fed on 25 dairy farms during two farm visits in summer. All samples were analyzed for nutrient composition, Degree of Starch Access (DSA), modified in vitro starch degradation (rumen fluid in vitro on 6 mm grind samples (MRSD) followed by enzymatic digestion (MPRSD) on the residue), and particle size. Kernel processing score (KPS) was determined on WPCS. In vitro NDF digestibility (IVNDFD) of WPCS was determined at 48- and 24-h. DM contents of HMC and WPCS were 73.7 ± 3.7% and 35.8 ± 4.7%, respectively. NDF and starch contents of WPCS were 40.6 ± 2.8% and 31.6 ± 3.6%, respectively. R-square value from multiple regression of DSA on DM content and mean particle size for HMC was 61% ($P < 0.0001$). For WPCS, DSA and MRSD were 93.7 ± 2.3% and 89.7 ± 5.4%, respectively. Total-tract in vitro starch degradability (MRSD+MPRSD) varied minimally (98.0 ± 1.1% of starch) for WPCS. DSA was positively ($r = 0.43$) correlated ($P < 0.05$) to KPS for WPCS. Whole-plant DM was unrelated ($P > 0.10$) to DSA or in vitro starch degradation parameters. Average 24-h IVNDFD was 19%-units lower than average 48-h IVNDFD (46% vs. 65% of NDF). R-square value from regression of 24-h on 48-h IVNDFD was only 33% ($P < 0.05$). Correlation ($P < 0.05$) between wet chemistry lignin (% of NDF) and IVNDFD was lower for 24-h than 48-h IVNDFD ($r = -0.28$ vs. -0.49). Results from this relatively small sample set indicate that 24-h IVNDFD was more variable and less related to lignin than 48-h IVNDFD, and that data from the two IVNDFD time points were not highly correlated. Recent assays to assess starch digestibility of corn grain and silage can aide our evaluation of these feeds in the field. More comparative research of these assays and research to validate their results relative to in vivo digestibility data is needed before they can be used with confidence in the field.

Key Words: Corn Silage, Starch, NDF

M74 Job satisfaction and interest in testing more cows: A survey of DHIA supervisors. J. C. Dalton*, *University of Idaho, Caldwell*.

Between 2003 and 2005, the number of dairy cows in Idaho increased by 45,000. During the same time period, twenty Idaho DHIA supervisors tested, on average, 114,784 cows (2003) and 119,120 cows (2005) and processed these records with a DRPC. In December 2005, Idaho had 472,000 dairy cows. To determine the level of interest of DHIA supervisors to test more cows, two surveys were conducted. DHIA supervisors (2003: n = 18; 2005: n = 17) in attendance at the 2003 and 2005 Annual Idaho DHIA Supervisor Conference were asked questions regarding length of time working as a supervisor, job satisfaction, number of cows tested per week, number of hours worked per week, and interest in testing more cows. For the years 2003 and 2005, respectively, 67% and 82% of supervisors reported being on the job greater than five years. When asked how satisfied they were with their job as a DHIA supervisor, the majority of supervisors responded that they were somewhat to very satisfied (56% and 65% for 2003 and 2005, respectively). Results showed that 72% and 75% of supervisors (for 2003 and 2005, respectively) tested more than 500 cows per week, while 100% and 86% of supervisors (for 2003 and 2005, respectively) reported working less than 60 hours per week. When asked if they were interested in testing more cows, 39% of supervisors responded yes, 28% responded no, and 33% were unsure according to the 2003 survey. In contrast, 17% of supervisors responded yes, 71% responded no, and 12% were unsure when asked in 2005 if they were interested in testing more cows. The results of these surveys suggest that although greater than half the supervisors expressed a high degree of job satisfaction, less than half the supervisors expressed an interest in testing more cows. Lastly, with continued dairy industry growth (Idaho had 500,000 dairy cows in December 2006 and was the fourth-largest milk producing state in the United States) and only 20 DHIA supervisors in Idaho, it is apparent that opportunities exist for current and future supervisors interested in testing cows.

Key Words: Dairy, DHIA Supervisor, Survey

M75 Use of real-farm case studies to teach nutrient management planners the value of feed management as part of whole farm nutrient management. R. A. White*[1], G. E. Erickson[2], R. K. Koelsch[2], R. E. Massey[3], V. R. Bremer[2], M. Fox[4], and J. H. Harrison[1], [1]*Washington State University, Puyallup*, [2]*University of Nebraska, Lincoln*, [3]*University of Missouri, Columbia*, [4]*KLA Environmental Services, Inc., Salina, KS*.

Feed management is an optional component of a Comprehensive Nutrient Management Plan (CNMP) and may be a viable option to decrease excess nutrients such as N and P on animal operations. The National Feed Management Education Project has developed assessment tools to facilitate development and implementation of a feed management plan (FMP) into a CNMP. The two audiences for the education program are animal nutritionists and nutrient management planners (planners). In most cases, collaboration between these two individuals is needed for successful completion of a FMP. The focus of this paper will be on the planner. The project team has chosen real-farm case studies as a teaching aid to illustrate and document the benefits of feed management. These case studies are used in separate, four hour education workshops to teach nutrient management planners about the five step process for development and implementation of a FMP. The goals of the workshops are to educate planners on the value of

feed management, encourage incorporation of a FMP into CNMP, and facilitate collaboration with animal nutritionists. Two feed management case studies were developed for Kansas feedlots (35,000 and 59,000 animal capacities). Both feedlots utilize nutritionists and private nutrient management planners. The case studies were developed by their planners who had previous knowledge of the operations. The objectives of the case studies were to 1) test practical use of the assessment tools in the field, and 2) use completed case studies as an educational resource when conducting feed management workshops. Feedback from the planner was used to improve the assessment tools for ease of use. Case study information was evaluated with a new software tool for assessing the dietary impact on land application and nutrient distribution costs. The completed FMP were used in a CNMP feed management workshop to instruct participants on how to use materials, illustrate the value of FMP, and what could be completed by someone with a similar background and knowledge of the material.

Key Words: Case Study, Education, Feed Management

M76 Comparison of somatic cell counts from fresh and frozen milk samples using the DeLaval DCC. W. D. Gilson*, L. O. Ely, and S. P. Nickerson, *University of Georgia*, *Athens*.

Milk somatic cell counts and culture results are valuable tools in determining the infection status for making decisions regarding further therapy or culling. Samples are often frozen before analysis. Freezing is generally regarded as harmful to somatic cells. There are limited reports comparing the results from fresh and frozen samples. Previous research indicates that fresh and frozen samples analyzed using fluoro-opto-electronic principles compare favorably. New equipment has been introduced based on the same principles. Aseptic quarter and composite milk samples were collected for microbiological culturing and refrigerated at 5 degrees C until processing. The samples were warmed to ambient temperature and plated to determine the microbiological status. Samples were vortexed and analyzed for somatic cells using the DeLaval DCC. The samples were subsequently frozen at -20 degrees C for a minimum of 2 weeks. Samples were thawed, allowed to warm to ambient temperature, vortexed and analyzed using the DeLaval DCC. Statistical analysis was performed using SAS to compare cell counts before and after freezing. Natural logarithmic transformation of the data was also performed to approximate a normal distribution. The mean SCC and LN SCC for fresh and frozen samples was 466,564, 454,918, 4.68 and 4.75, respectively. Differences were not statistically different. The correlations between the fresh and frozen samples were .914 and .934 for actual and LN. The data were further grouped according to the relative time in the lactation cycle the sample was collected. The actual SCC's for samples collected during the first 3 days following parturition were statistically different (P>.002) while the LN was not significantly different. No statistical differences were found for any of the other groups. These results indicate that cell counts determined by the DCC from frozen samples may be useful in evaluating infection status. Log transformation normalizes the data resulting in more accurate information. Further research is necessary to confirm the relationship between cell counts on fresh and frozen milk samples.

Key Words: Somatic Cell Count, Milk Quality

M77 A milk quality management survey of Minnesota DHI dairies with consistently low somatic cell counts. J. K. Reneau*, T. Bartholomay, and J. M. Lukas, *University of Minnesota*, *St Paul*.

A milk quality survey was professionally designed to assess the milk quality attitudes and management practices among Minnesota DHI herds with the lowest average somatic cell counts. Seventy-seven of the 104 surveys mailed were completed and returned. Five were eliminated not meeting SCC criteria of < 160,000. For the remaining 72 herds the mean herd size was 107 cows with a range of 32 – 415 cows. Bulk tank Somatic cell counts (BTSCC) mean and variation was 118,000 & 19,700 respectively. The average was standard plate count was 3,400. Rolling herd average milk production was 10,412 kgs. Questions reflecting the seven habits of highly effective people were asked. Responses indicate: 87% are proactive, 79% have vision, 84% put first things first, 79% seek win-win relationships with employees and farm consultants, 53% try to understand then be understood, 73% value synergy, clear communications and teamwork, Only 50% indicate they value personal improvement for themselves and employees yet 92% report keeping up to date on latest SCC issues. 99% think that doing the job right is more important than getting done fast. 76% report that their milkers enjoy milking. By self assessment cow composite hygiene score (scale 1-5) for lower rear legs and udders was 2.12. 91% remove manure and soiled bedding at each milking; 76% using organic bedding re-bed daily and 64% use more than 1 inch of bedding; 83% using sand re-bed weekly 94% keeping sand at minimum level to curb; 72% use full 10-20 seconds per cow pre-milking teat prep; 75% fore-strip; 82% report they always or almost always achieve complete pre-dip coverage and 93% report achieving complete post dip coverage; 91% dry cow treat all cows all quarters and 67% use internal sealers for all dry cows; 78% provide formulated dry cow diets. Responses indicating need for improvement: 56% indicate milking machine checks only when needed or once per year and although 52% indicate they keep some clinical mastitis treatment records only 19% keep detailed treatment records.

Key Words: Milk Quality, Attitudes, Management Practices

M78 Poultry nutrition and disease knowledge in California exhibition poultry owners: A survey. B. A. McCrea*[1], T. Y. Morishita[2], and F. A. Bradley[1], [1]*University of California*, *Davis*, [2]*Western University of Health Sciences*, *Pomona, CA*.

Survey responses from California exhibition poultry owners were collected using a set of questions developed in a previous study at Ohio State University. Our objective was to determine the perception and level of knowledge in this group with regard to poultry health management and nutrition topics. Surveys were given to adult and youth (i.e., 4-H and FFA) exhibitors. Surveys were handed out at exhibition poultry shows between October 2006 and March 2007. Show locations attended include the central valley, central coast, and north coast regions. In general, participants, both young and old, were more knowledgeable about poultry health management topics than nutrition topics. Our results indicate that there is a distinct lack of knowledge regarding antibiotic use and vaccination. Participants had little knowledge of poultry digestive anatomy. These topics may be more effectively communicated if the basic level of understanding can be determined. Poultry extensionists can use the information from this survey to develop materials and continuing education programs incorporating poultry health and nutrition.

Key Words: Exhibition Poultry, Health Management, Nutrition

M79 Cull cow and calf marketing methods employed by Idaho dairies. M. Chahine and J. B. Glaze, Jr.*, *University of Idaho*, *Twin Falls*.

To assess the awareness, knowledge, understanding, and implementation of beef quality assurance (BQA) principles on Idaho dairies, a survey of dairy farmers in Idaho was conducted. Each of the 736 known dairies operating in Idaho received copies of the survey. Two-hundred, thirty six dairies returned the survey for an overall response rate of 37%. One section of the survey inquired about the cull cow and calf marketing methods employed by Idaho dairies. The marketing questions offered auction market, order buyer, forward contract, and private treaty, as marketing options for cull cows and calves. An additional marketing option listed for cull cows was direct market to the packer. To determine which marketing methods were most used by dairies, survey participants were asked to select any or all of the marketing options used by their dairy. The selections were compiled and used to assign use percentages. As dairies market their cull cows, they use auction markets most often (64%), followed by order buyers (17%), direct to the packer (17%), private treaty sales (16%), and forward contract (1%). The most used calf marketing method was private treaty sales (52%), followed by auction markets (42%), order buyers (14%), and forward contracts (1%). When the selections were compiled based on dairy size, results indicated that large dairies (more than 1000 cows) used auction markets most often (62%) to market their cull cows, followed by order buyers (33%), private treaty sales (23%), and direct to the packer (23%). Medium-sized dairies (200-1000 cows) favored auction markets (61%) over direct to the packer (17%), private treaty sales (15%), and order buyers (14%) when marketing cull cows. Small dairies (less than 200 cows) chose auction markets (66%) to market their cull cows more often than direct to the packer (15%), private treaty sales (14%), and order buyers (13%). Regardless of size, dairies chose private treaty sales over auction markets, order buyers, and forward contracts to market their calves.

Key Words: Marketing, Cull Cow, Calves

M80 Financial performance of dairies in Florida and Georgia in 2005. L. O. Ely*[1], R. Giesy[2], B. Broaddus[2], C. Vann[2], A. Bell[2], and A. deVries[2], [1]*University of Georgia*, *Athens*, [2]*University of Florida*, *Gainesville*.

The Dairy Business Analysis Project (DBAP) includes an annual survey of the financial performance of dairies primarily located in Florida and Georgia. Its objective is to document the dairies' financial success using standardized, accrual accounting methods in order to calculate benchmarks and provide feedback on the dairies financial strengths and weaknesses. Twenty-six dairies submitted financial data in 2005. Twenty-one dairies were included in the summary results. Of these, 15 were located in Florida, and 6 in Georgia. The average herd size was 1,045 cows and 538 heifers with 18322 lbs. milk sold per cow. The average culling rate was 36%. There was an average of 19 FTE workers per farm and 0.93 million lbs milk sold per FTE worker. Total revenue per cwt. was $20.73 / cwt with $18.24 / cwt milk income. The average total expense was $20.20 / cwt. The largest expense items were purchased feed ($7.22 / cwt), labor ($3.50 / cwt), livestock ($2.01 / cwt) and milk marketing ($1.22 / cwt). Net farm income from operations was $0.53 / cwt and net farm income was $0.07 / cwt. The debt to asset ratio was 0.39, the rate of return on assets was 0.04, the rate of return on equity was 0.02, the operating profit margin ratio was 0.02. Total expenses decreased and returns increased with herd size in 2005. Herds >670 cows had the middle total revenue ($20.44 / cwt) and the lowest expenses ($17.65 / cwt) resulting in the highest net farm income ($2.79 / cwt). The herds with the highest milk production (>19,500 lbs / cow / year) had the middle total revenue ($20.29 / cwt) and the lowest expenses ($18.98 / cwt) resulting in the highest net farm income ($1.19 / cwt).

Key Words: Dairy, Financial, Management

Food Safety - Livestock and Poultry

M81 Preventing *Salmonella* colonization in cement using Bio Deep Seal. K. S. Macklin*, J. B. Hess, and D. E. Conner, *Auburn University*, *Auburn, AL*.

Salmonella is an important foodborne pathogen that is often associated with poultry. Unfortunately, the ability to properly clean and disinfect an area to remove this pathogen and/or other bacteria can be difficult. This is especially true in a constantly wet environment, such as that typically found in a poultry processing plant. In this study a commercial product (Acon Bio Deep Seal) that claimed to kill, encapsulate or displace bacteria was tested. This product was tested on cement blocks that had been impregnated with *Salmonella typhimurin*. To test the product an experiment was designed to include four treatments that were tested in five blocks each. The four treatments were an unchallenged group (CON), a challenged untreated group (CHAL), a challenged/pre-challenged treated group (PRE), and a challenged/post-challenge group (POST). The PRE group was treated with the product according to the manufacturer specifications. After 1 h, the PRE, CHAL, and POST blocks were placed in a broth that contained approximately 5 x 10^9 cfu/mL of a *S. typhimurin*. After 24 h, the blocks were removed and the POST group was treated. After 6 h from removal from the broth, swabs were taken of the surface from each block. After the external swabs were taken, internal swabs were also obtained. Swabs were taken in duplicate with one swab being placed in TTB Hajna and the other being used for direct plating onto XLT4. After 24 and 48 h of incubation, the XLT4 plates were examined for presence of *Salmonella*. The TTB blocks were incubated for 48 h before being streaked onto XLT4. *Salmonella* counts (cfu/cm^2) for the XLT4 plates were transformed using log10. The data were analyzed using the GLM procedures of SAS with $P < 0.05$ and the means were separated using Tukey's HSD. *Salmonella* was detected on the block's exterior from treatments CHAL and PRE, but not from the CON and POST treatments. *Salmonella* was detected on the interior of the blocks only from the CHAL group. The results showed that Bio Deep Seal is an effective cement treatment to eliminate *Salmonella* when it is applied either before or after the cement was exposed to the pathogen.

Key Words: *Salmonella*, Disinfection, Cement

M82 Effects of transport stress on subclinical infection in an *Escherichia coli-Listeria monocytogenes* challenge model. G. R. Huff*[1], W. E. Huff[1], V. Dutta[2], R. Nannapaneni[3], and M. G. Johnson[3],

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We hypothesized that stress-induced subclinical infection of turkeys with *Listeria monocytogenes* (Lm) may be a source of contamination in processing plants and we have shown that concurrent *Escherichia coli* challenge can increase Lm colonization. The objective of this study was to determine effects of transport stress on isolation of Lm in an *E. coli*-Lm challenge model. Thirteen-wk-old male turkeys housed in floor pens were challenged by exposure to *E. coli* and Lm Scott A using coarse spray and feed inclusion. Positive controls were given an immunosuppressive dose of dexamethasone (Dex) during challenge. At 15 wk, a sample of birds was subjected to 12 h transport stress and all birds were bled and necropsied the following morning. Leukocyte numbers and percentages and hematological indices were determined. Knee and hip joints were sampled using transport swabs and cultured using pre-enrichment in University of Vermont medium and Fraser broth, and isolation of Lm on Listeria selective agar plates. Challenged birds, challenged-transported birds, and challenged-Dex or Dex treated birds had lower ($P < 0.05$)BW than the controls. Isolation of Lm was achieved from the knee or hip joints of 71% of challenged-Dex treated birds, 44% of challenged birds, and 23% of challenged-transported birds. Peripheral blood leukocyte count and percentage of heterophils (H) increased ($P < 0.05$) by Dex and by Transport. Dex decreased ($P < 0.05$) percentage of lymphocytes (L). The H/L ratio increased ($P < 0.05$) by Dex. Total erythrocyte counts, hematocrit, and hemoglobin decreased by Dex ($P < 0.05$) and by Transport ($P < 0.09$). The data suggested that subclinical infection with Lm can result from environmental exposure and Dex treatment could increase incidence of Lm colonization. Transport stress also tend to decrease Lm isolation from hip joints relative to unstressed challenged birds and this effect may be related to an increase in heterophil numbers.

Key Words: Turkeys, *Listeria monocytogenes*, Transport

M83 A dual system based on the use of electronic identification and molecular markers to ensure lamb traceability. G. Caja*, J. J. Ghirardi, M. Hernández-Jover, and A. Sánchez, *Universitat Autònoma de Barcelona*, *Bellaterra, Spain*.

As a part of a European Union project (FAIR5 QLk1-2001-02229: EID+DNA Tracing) the efficiency of a dual traceability system based on animal electronic identification (e-ID), by radiofrequency boluses (Rumitag, Barcelona, Spain) containing low-frequency (LF, 134.2 kHz) transponders of 32 mm, and genetic fingerprinting (DNA) by analyzing specific sets of ovine microsatellites (n = 12) in biopsies, was evaluated. A high-frequency (HF, 13.56 MHz; Tiris, Almelo, Holland) read-write inlay transponder (45 × 76 mm) was used for transferring e-ID code to the carcass. All animals also had visual ear tags (VE). Lambs (n = 1,908) on seven farms (Badajoz and Barcelona, Spain) were e-ID during suckling by using two LF mini-boluses (B1 [9 g; 10 × 39 mm; n = 1,091] and B2 [20 g; 11 × 56 mm; n = 817]). At bolus administration, biopsying ear tags (BE) were also attached (n = 980; Biopsytec, Rheinbach, Germany). Lambs were slaughtered before 3 mo of age in two commercial abattoirs. Mini-boluses were automatically read just before evisceration by a LF transceiver interfaced with a HF recorder. Bolus LF code was transferred to HF labels which were attached on the shank of the carcass after recording. Carcass samples (n = 868) were taken by using sampling tubes (Biopsytec). Ear and carcass samples were frozen until DNA analysis. On-farm traceability was lower for VE (96.8%) than for BE (99.7%), B1 (98.4%) and B2 (100%). Semi-automatic data transfer to carcasses was 98.9% successful. Abattoir traceability as well as total traceability differed between B1 (97.7 and 96.1%) and B2 (99.9 and 99.9%), respectively. When tracing back of carcasses to lambs in 50 random samples, one pair did not match (2.0%), showing 98.0% lamb traceability. In conclusion, the dual e-ID and DNA tracing system showed high traceability efficiencies (98%) under practical conditions, although improvement in label design and reading equipment is needed.

Key Words: Traceability, Transponder, Fingerprinting

M84 Reduction of cecal *Campylobacter* spp. in broiler chickens by egg powder, mannobiose, or their combination. Y. Han, G. I. Page*, and J. J. Brennan, *Maple Leaf Foods Agresearch*, *Guelph, Ontario, Canada*.

Fresh chicken is the main risk factor for human Campylobacteriosis. Two trials were conducted to study effects of dietary addition of egg powder (EP) or mannobiose (MB) on number of *Campylobacter* spp. in broiler chickens. In Exp. 1, 240 birds were fed the same medicated diet until d 34. From d 35 to 42, four different diets were fed to six pens (replications) per treatment (10 birds/pen). The following test material was added into the medicated (55 ppm bacitracin) control diet: 5% EP, 130 ppm MB, or 13 ppm MB. On d 29, 37, 39, and 42, two birds per pen were sacrificed for cecal *Campylobacter* counts. In Exp. 2, five experimental diets were fed to six pens (replications) per treatment (15 birds/pen) of 450 d-old chicks for 2 wk, followed by a common feed until d 41. The following product was added into a medicated control diet, 5% EP, 130 ppm MB, 5% EP + 130 ppm MB, or 2.5% EP + 65 ppm MB. On d 14, 21, 28, and 41, two birds per pen were analyzed for cecal *Campylobacter* counts and cecal total IgA. In both experiments, the test materials did not affect ($P > 0.05$) growth performance or mortality of the birds. In Exp. 1, all birds were positive for *Campylobacter* by d 29. No differences ($P > 0.05$) in cecal *Campylobacter* counts were found on d 37 or 39. However, on d 42, birds fed the 5% EP had lower ($P < 0.05$) *Campylobacter* counts than those fed the Control or the 13 ppm MB diet (0.94 vs 2.50 or 2.69 log cfu/g), but not different ($P > 0.05$) from those fed the 130 ppm MB diet (2.09 log cfu/g). In Exp. 2, the test materials did not prevent the newly placed birds from being colonized by *Campylobacter* by day 14. By d 41, the cecal *Campylobacter* counts in the control birds were numerically higher ($P > 0.05$) than those in the birds fed the 5% EP, the 130 ppm MB, the combination of both, or the 2.5% EP + 65 ppm MB diets (2.61, .98, 1.03, 1.27, or 1.20 log cfu/g, respectively; $P = 0.09$). Cecal total IgA concentrations on d 41 were higher ($P < 0.05$) in the birds fed the EP, the MB, or the combination diets than in those fed the control diet. It was concluded that egg powder and mannobiose could be used to reduce *Campylobacter* colonization in broiler chickens.

Key Words: *Campylobacter* spp., Egg Powder, Mannobiose

M85 Development of a polymerase chain reaction-based method to identify poultry, ruminants, and equine components in fish meal. A. Heravi Moussavi*[1], M. Nassiri[1], G. Pourseifi[1], M. Soltani[1], A. Javadmanesh[1], and R. Noorbakhsh[2], [1]*Ferdowsi University of Mashhad*, *Mashhad, Khorasan Razavy, Iran*, [2]*Standards*

and Industrial Research, Khorasan Razavy Head Office, *Mashhad, Khorasan Razavy, Iran*.

Fish meal is a widely used feedstuff for poultry and ruminants. The objective of this study was to develop a polymerase chain reaction (PCR)-based method to identify poultry, ruminants, and equine components in fish meal. In this experiment, 10 different available commercial fish meals were used. The nitrogen contents were measured using the Kejeldal method to investigate the correlation between nitrogen contents and the possible non-fish species components. Mitochondrial DNA extraction was carried out using a commercial kit based on phenol-chloroform method. Specific primers for every species were designed and calibrated to generate exclusively a PCR product with a specific size when DNA for each species was present in the sample. Blood samples of hen, cow, sheep, and horse were run as the positive controls. The results demonstrated that only two products were not contaminated and the others were contaminated with at least one of the species. The correlation between nitrogen content and possible non-fish species components was not significant ($P = 0.57$; $r = 0.2$). The results demonstrated that evaluation of fish meal by measuring its CP content is not accurate and it should be evaluated by other methods such as PCR-based methods. It is recommended that PCR methods to be considered for feedstuff standards as tools to assure quality.

Key Words: Fish Meal, PCR, Adulteration

M86 Detection of *Escherichia coli* O157:H7 using Au nanoparticles mediator on an electrochemical amperometric immunobiosensor. S.-H. Chen*[1], Y.-H. Lin[1,2], Y.-C. Chuang[1], Y.-R. Lin[1], C. A. Chang[1], T. Y. Shen[2], and C.-S. Lin[1], [1]*National Chiao Tung University*, *Hsinchu, Taiwan, R.O.C*, [2]*Apex Biotechnology Corporation*, *Hsinchu, Taiwan, R.O.C*.

A screen-printed carbon electrode (SPCE) immunobiosensor, based on 13-nm Au nanoparticles (AuNPs) as mediator for amplifying electronic conduction and detection signal, was used for real-time detection of *Escherichia coli* O157:H7. We investigated the impact of electronic conduction using horseradish peroxidase (HRP) reacted to hydrogen peroxide (H_2O_2) through an AuNPs-modified SPCE surface. The AuNPs were used to increase electron conductivity and surface area of SPCE for amplifying detection current in developing immunobiosensing system. In the assembling process of SPCE, the AuNPs-mediator was first addressed onto the SPCE surface and immobilized the first specific antibody against *E. coli* O157:H7. The modified SPCE was then used to detect the samples containing *E. coli* O157:H7. After the procedures of detection and washing, the SPCE was treated with the second *E. coli* O157:H7 specific antibody conjugated with HRP, and reacted to H_2O_2, the free electron generated could be detected by an electrochemical amperometric biosensor. The detection results demonstrated that the 13-nm AuNPs, as in an immunobiosensor mediator, could enhance the current around 60 folds compared with those without AuNPs-modified electrodes. The AuNPs-modified SPCE developed in this study enabled the detection of *E. coli* O157:H7 at a low concentration of 10^2 cfu/strip within 1 h and the reproducibility reaches 85%, which shows that this technique is more efficient than traditional culture plate methods. The SPCE immunobiosensing system has potential for further applications and lays the groundwork for incorporating the method into an integrated system for rapid pathogen detection.

Key Words: *Escherichia coli* O157:H7, Screen-printed Carbon Electrode, Immunobiosensor

M87 Effect of heat treatments on stability of β-lactams in milk. M. Roca[1], M. A. Zorraquino[2], C. Igualada[3], R. L. Althaus[4], and M. P. Molina*[1], [1]*Universidad Politecnica de Valencia*, *Valencia, Spain*, [2]*Universidad Publica de Navarra*, *Pamplona, Spain*, [3]*Generalitat Valenciana*, *Valencia, Spain*, [4]*Universidad Nacional del Litoral*, *Esperanza, Republica Argentina*.

The presence in milk of residues of antimicrobial substances may have serious toxicological and technical consequences. Studies referring to the influence of heat treatments on antimicrobial residues in milk are very scarce. The objective of the study was to analyze, using HPLC assays, the effect of different heat treatments (60, 70, 80, 90, and 100°C at six different times) on milk samples fortified with 5,000 μg/kg of penicillin, amoxycillin, ampicillin, cloxacillin, cephalexin, cephalonium, cefquinome, cefoperazone, cephapirin, and cephuroxime. The half-life (losses of 50% of the initial concentration) calculated for β-lactams showed that penicillins are more stable molecules than cephalosporins. Using the obtained prediction equations, the thermal loss percentages in concentration for the frequent heat treatments carried out in the control laboratories and dairy industry, are calculated. The results showed that the sample homogenization (40°C for 10 min) caused no inactivation in most of the β-lactams, whereas heating to 83°C for 10 min to inactivate the natural milk inhibitors, caused a small reduction in penicillin concentrations, around 6%, but a higher one in cephalosporins (15 to 53%). The LTLT pasteurization (60°C for 30 min) caused less degradation (3 to 6%), somewhat higher in the cephalosporins (16 to 43%). The HTST pasteurization (72°C for 15 s) produced very small losses in all β-lactams (< 1%). In contrast, sterilization (120°C for 20 min) produced a marked heat degradation ranging between 47% (amoxicillin) and 93% (ampicillin) for the penicillins and greater than 90% for most cephalosporins. In turn, the inactivation percentages of the treatment at 140°C for 10 s (UHT) are low for nearly all β-lactams, being situated between 1 and 8%, and moderate for cephuroxime (19%) and cefoperazone (37%). In conclusion, only sterilization produced a high inactivation level of β-lactams in milk. The other treatments were no guarantee that these molecules would lose their antimicrobial activity.

Key Words: Antibiotics, Milk, Thermostability

M88 Effects of feed withdrawal times prior to slaughter on cecal fermentation and *Salmonella* shedding at the abattoir. S. Martín-Peláez[1], E. Creus[1], B. Peralta[2], J. F. Pérez*[1], E. Mateu[2], and S. M. Martín–Orúe[1], [1]*Animal Nutrition, Management and Welfare Research Group, Universitat Autònoma de Barcelona*, *Spain*, [2]*Departament de Sanitat i Anatomia Animals, Universitat Autònoma de Barcelona*, *Spain*.

The objective of this study was to determine whether different times of feed withdrawal in pigs prior to slaughter have any effect on cecal fermentation and *Salmonella* shedding. One commercial farm subclinically infected with *Salmonella* (prevalence of carriers = 13%) was studied. Two groups of pigs (45 each) were either deprived of feed for 15 or 30 h before slaughter. Fecal samples were collected the day before slaughter at the farm. The weight of the gastrointestinal tract (GIT) was recorded and fecal samples from the rectum were collected for *Salmonella* detection. Cecal samples were also collected to evaluate possible changes in pH, concentrations of short chain fatty acids (SCFA) and NH_3, and numbers of lactobacilli and enterobacteria by means of qPCR. The GIT weight decreased ($P < 0.05$) with increasing feed withdrawal time (6.76 vs 6.39 kg) whereas cecal pH (5.9 vs 6.4)

increased ($P < 0.05$). Concentration of total SCFA (89.5 vs 77.8 mM) decreased ($P < 0.05$) with increasing feed withdrawal time but the percentage of branched SCFA (1.9 vs 3.1%) increased ($P < 0.05$). The NH_3 concentration (366.6 vs 769.3 mg/L also increased ($P < 0.05$) with increasing feed withdrawal time. The numbers of enterobacteria (8.7 vs 9.1 log 16 S rDNA copies/g FM) increased ($P = 0.08$) with increasing feed withdrawl time whereas the numbers of lactobacilli (9.6 vs 9.0 log 16 S rDNA copies/g FM) decreased ($P < 0.05$). The percentage of pigs with *Salmonella* in the rectal contents was higher ($P < 0.05$) in the group that was fasted for 30 h (18 vs 33%). The results suggested feed withdrawl for a short period of time (e.g., 15 h) to have the potential to decrease presence of *Salmonella* in the GIT of pigs arriving at the abattoir.

Key Words: Swine, *Salmonella*, Feed withdrawal

M89 Efficacy of a micro-encapsulated or non-encapsulated blend of lactic and formic acid to reduce the prevalence of *Salmonella* in finishing pigs. J. dos Santos[1], E. Creus[1], J. F. Pérez*[1], E. Mateu[2], and S. M. Martín–Orúe[1], [1]*Animal Nutrition, Management and Welfare Research Group, Universitat Autònoma de Barcelona*, *Spain*, [2]*Departament de Sanitat i Anatomia Animals, Universitat Autònoma de Barcelona*, *Spain*.

Micro-encapsulated acids in the feed have been proposed to increase acid concentrations in the posterior sections of the gut. The objective was to examine if an economically affordable dose of protected acid could improve efficacy of a non-protected blend in reducing *Salmonella* in finishing pigs. One commercial farm subclinically infected was selected. A total of 261 pigs were allocated to three dietary groups that included a control (CTR), the CTR with a blend of lactic and formic acids added at 0.4% each (NPB), and the CTR diet with a lipid microencapsulated blend of each acid (0.14% each) added (PB). The pigs had ad libitum access to the diets for 5 wk. Blood samples for ELISA were taken before starting the diets (d-0) and immediately after slaughter (d-36), and fecal samples were collected on d-0 and d-36 for microbiology tseting. Cecal contents were also collected for measuring pH, short chain fatty acids (SCFA), and both formic and lactic acids. No change was detected in cecal pH but increased concentrations ($P < 0.05$) of formic and lactic acids were detected with feeding the NPB diet (3.2 and 12.9 mM, respectively) and the PB diet (4.0 and 11.6 mM, respectively) compared with feeding the CTR diet (2.0 and 4.8 mM, respectively). Concentrations of SCFA were higher ($P < 0.05$) with feeding the PB diet (233 mM) than with feeding the CTR (177) or the NPB (173) diets. Five weeks of feeding the NPB diet decreased ($P < 0.05$) seroprevalence (from 59.4 to 8.8%) but not the rest of diets. No change in *Salmonella* shedding was detected from d-0 to d-35. However increases ($P < 0.05$) were found after transport to the abattoir with feeding the CTR (12.5 vs 77.4%) and the PB (0 vs 17.4%) diets, but not with the NPB diet (0 vs 3.3%). The results suggested that inclusion of a non-protected blend of formic and lactic acids in finishing diets could decrease *Salmonella* seroprevalence in swine. The microencapsulated blend, however, did not decrease *Salmonella* prevalence.

Key Words: Swine , *Salmonella*, Acidifiers

M90 Effects of feed withdrawal and lairage time prior to slaughter on the gut environment and cecal *Enterobacteriaceae* in finishing pigs. S. Martín–Peláez[1], S. M. Martín–Orúe[1], J. F. Pérez*[1], A. Dalmau[2], E. Fàbrega[2], A. Velarde[2], J. Tibau[2], and J. Gasa[1], [1]*Animal Nutrition, Management and Welfare Research Group, Universitat Autònoma de Barcelona*, *Spain*, [2]*IRTA*, *Monells, Girona, Spain*.

The objective of this study was to determine effects of different feed withdrawal and lairage times prior to slaughter on the gut environment of pigs and also on growth of *Enterobacteriaceae* as a possible marker of *Salmonella* shedding. Two groups of finishing pigs (36 each) were deprived of feed for 2 or 12 h before their lairage at the slaughterhouse. Each group was divided into three subgroups and held in different holding pens for 0, 5, or 10 h before slaughter. The weight of the gastrointestinal tract (GIT) was determined and samples of cecal contents were collected to measure pH, short chain fatty acids (SCFA), and the numbers of lactobacilli and enterobacteria by means of qPCR. The GIT weight decreased ($P < 0.05$) with feed withdrawal (6.8 vs 5.7 kg) but not with increasing lairage time. Similarly cecal pH increased ($P < 0.05$) only with feed withdrawal (6.14 vs 6.55). Cecal concentration of total SCFA decreased ($P < 0.05$) with feed withdrawal (165 vs 125 mM) and increasing lairage time (182, 147, and 105 mM for 0, 5, and 10 h, respectively). Lactobacilli population decreased ($P < 0.05$) with increasing lairage time (10.0, 9.3, and 8.6 log 16 S rDNA copies/g FM for 0, 5, and 10 h, respectively) whereas *Enterobacteriaceae* increased ($P < 0.05$) with feed withdrawal (9.0 vs 9.5 log 16 S rDNA copies/g FM) and increasing lairage time (8.9, 9.4, and 9.6 log 16 S rDNA copies/g FM for 0, 5, and 10 h, respectively). The results showed that antemortem feed depriviation time can have a significant impact on intestinal environment and potential growth of pathogens of the *Enterobacteriaceae* family.

Key Words: Swine, Pathogens, Feed Withdrawl

M91 The relationship between *Salmonella* detection from milk filters and bulk milk and fecal shedding of *Salmonella* in a dairy herd. J. S. Van Kessel*[1], J. S. Karns[1], D. R. Wolfgang[2], E. Hovingh[2], and Y. Schukken[3], [1]*USDA-ARS-EMSL*, *Beltsville, MD*, [2]*The Pennsylvania State University*, *University Park*, [3]*Cornell University*, *Ithaca, NY*.

Although dairy cattle are known reservoirs for *Salmonella*, cattle that are shedding this pathogen are often asymptomatic and difficult to identify. A dairy herd experiencing an outbreak of *Salmonella enterica* subsp. *enterica* Cerro was monitored for 2 yr. Fecal samples from lactating cows were collected every 6 to 8 wk and were tested for presence of *Salmonella* using traditional culture methods. Fecal shedding of *Salmonella* fluctuated throughout the test period and the prevalence ranged from 8 to 88%. During this period, bulk milk and milk filters were also tested for *Salmonella* on a weekly basis. *Salmonella* was detected in 15% of milk samples (n = 109) and in 78% (n = 107) of milk filters. Results of weekly bulk milk quality testing (i.e. bulk tank somatic cell score, standard plate count, and preliminary incubation count) were typically well within acceptable ranges. The recovery of *Salmonella* from milk filters and to a lesser extent from bulk milk, closely matched that from the feces. Analysis of in-line milk filters has been used previously as a useful method to detect presence of zoonotic bacteria entering bulk tanks. It is concluded that milk filter analysis could be used as a convenient method for monitoring *Salmonella* shedding in dairy herds.

Key Words: *Salmonella*, Dairy Cattle, Pathogens

M92 Validation of peracetic acid as an antimicrobial for poultry chillers. S. R. McKee*, L. J. Bauermeister, and J. W. Bowers, *Auburn University*, *Auburn, AL*.

Spectrum™ (peracetic acid; PAA) has been approved as an antimicrobial for use in poultry chillers. To validate its effectiveness, laboratory and commercial trials were conducted. In the laboratory trials, 200 poultry carcasses were inoculated with *Salmonella* (10^6 cfu) and were randomly allocated into chill water containing chlorine (30 ppm) or PPA (25, 100, or 200 ppm). The results illustrated that PPA concentrations of 100 or 200 ppm to effective in reducing *Salmonella* when compared with the chlorine treatment. A sensory study was also conducted with another set of 200 carcasses (not inoculated) treated with water, chlorine (30 ppm), or PPA (100, 150, or 200 ppm). Sensory panels and microbial data were collected weekly on randomly sampled carcasses that were stored at 4°C for 21 d. The PAA-treated carcasses at 150 and 200 ppm had an extended shelf life that ranged from 3 to 4 d beyond those treated with water or chlorine. On d 15, the only treatments that could be served to sensory panelists were the carcasses treated with 150 or 200 ppm PAA. The carcasses treated with water, chlorine, or 100 ppm PPA had off-colors, off-odors, and high microbial counts. In another trial, 65 ppm PPA was compared with the 30 ppm chlorine treatment in a commercial setting. In this trial, 100 carcasses were sampled for *Salmonella* prior to the chiller and 100 were sampled after chilling. In all, 400 carcasses were sampled using 65 ppm PPA in the chiller and 400 carcasses were sampled using the chlorine treatment. *Salmonella* was reduced by 90% using the 65 ppm PPA treatment and it was reduced by 55% using the chlorine treatment. Peracetic acid appears to be an effective antimicrobial in poultry chillers. It also appears to have the potential to extend the shelf-life of poultry when used at concentrations of 150 or 200 ppm.

Key Words: *Salmonella*, Poutlry Chilling, Peracetic Acid

M93 Evaluation of rep-PCR and denatured gradient gel electrophoresis (DGGE) in identifying *Salmonella* serotypes isolated from processed turkeys. P. N. Anderson*[1], M. E. Hume[1,2], J. A. Byrd[1,2], and D. J. Caldwell[1], [1]*Texas A & M University*, *College Station*, [2]*USDA-ARS, FFSRU*, *College Station, Texas*.

Salmonella has been reported as the leading foodborne pathogen in the U.S. Researchers are continually evaluating different molecular typing methods to identify the most suitable technique that is able to discriminate among *Salmonella* serotypes. A study was conducted to compare the use of automated repetitive extragenic palindromic (rep-PCR) and denaturing gradient gel electrophoresis (DGGE) as diagnostic tools for identifying *Salmonella* serotypes. The interspersed conserved repetitive sequence of the bacterial genome and the 16-23S rDNA intergenic spacer region were amplified for rep-PCR and DGGE, respectively. Fifty-three *Salmonella* isolates from two turkey processing plants (A and B) were used for this comparison: Brandenburg, Derby, Hadar, and Typhimurium with n = 6, 21, 12, and 15, respectively. The rep-PCR was fully automated, while DGGE was run on an acrylamide gel and the image was captured digitally and the dendrograms were created using the unweighted pair group method with arithmetic average. There were more variations in percentage similarity in DGGE when compared with rep-PCR. The banding patterns were more distinct and uniform in the rep-PCR group than with DGGE group. The results from the rep-PCR were generated within an hour, while the DGGE required nearly a day to run. The data suggested that DGGE and rep-PCR are useful tools for identifying *Salmonella* serotypes. In addition, rep-PCR is more rapid, may have a higher discriminatory power, but may be less cost effective than DGGE.

Key Words: *Salmonella*, Detection, Molecular Methods

M94 Association between on-farm milk and wash water temperature variations and bulk milk coliform counts. J. C. F. Pantoja, C. Hulland, G. J. M. Rosa, D. J. Reinemann, and P. L. Ruegg*, *University of Wisconsin*, *Madison*.

The objective was to determine the impact of temperature variations during milk storage and wash procedures on bulk milk coliform counts. Data were collected from two dairy farms between July and December, 2006. Farm A had 1,110 lactating cows that produced 42,184 kg milk/d with a log somatic cell counts (SCC) of 5.01. Farm B had 400 lactating cows that produced 13,607 kg milk/d with a log SCC of 5.04. Cows in both farms were housed in freestalls and were milked in parallel parlors. Both farms cooled milk using plate coolers, loaded milk directly into tankers, and had temperature recording charts for monitoring milk and wash water temperatures with sensors located in the milk line between the chiller and the tanker entry. The farms were visited monthly and daily somatic cell, standard plate, coliform, and laboratory pasteurized counts were downloaded from the processor website. Temperature charts were examined to detect minor temperature failures (temperature recorded between 7.2 and 10.0°C), major temperature failures (>10°C) and failure to reach 60°C during wash cycles (wash failures). The association between the occurrence of failures and coliform spikes (values above 100 cfu/mL) was analyzed using SAS. The distribution of failures, was minor (n = 101), major (n = 49), and wash failure (n = 11). Coliform counts varied between 0 and 1,500 cfu/mL and there were 32 occurrences of spikes. The occurrence of temperature failures was associated with occurrence of coliform spikes (P = 0.001) and the risk of a coliform spike was 3.58 higher when > 1 temperature errors occurred within a 2-d interval. Coliform spikes and temperature errors decreased from summer to winter. For the two farms investigated, there was an association between coliform count spikes and temperature variations. The results contribute to increasing the understanding of the complex factors impacting microbial ecology of raw milk.

Key Words: Milk Quality, Milking, Bcteria

M95 Meat quality and microbial shelf life of chicken breast fillets from air or immersion chilled processing systems and packaged under modified atmospheres. D. Monsalve*[1], H. Thippareddi[1], and S. Russell[2], [1]*University of Nebraska*, *Lincoln*, [2]*University of Georgia*, *Athens*.

The effects of modified atmosphere packaging (MAP) on microbial shelf life, lipid oxidation, and color stability of chicken breast fillets were determined during refrigerated storage. Chicken breast fillets were obtained from an air-chill and an immersion-chill establishment. Fillets were packaged aerobically (tray-pack) or under vacuum or flushed with nitrogen. Breast fillets for each packaging system were stored at 1 or 5°C. Changes in color, TBARS (2-thibarbituric acid-reactive substances), and microbiota were determined at 1, 7, 14, and 21 d of storage. Storage of breast fillets at 1°C and under a modified atmosphere (vacuum and nitrogen flush) extended the shelf life of the breast fillets, with lower microbial populations throughout the storage period. Vacuum and nitrogen flush packaged samples had

lower ($P < 0.001$) TBARS values (2,688 and 3,319 µg MDA/kg) than the aerobically-packaged samples (4,752 µg MDA/kg). Color values for lightness (L*), redness (a*), and yellowness (b*) were lower ($P < 0.001$) in air-chilled samples than in the immersion-chilled samples. The results indicated that modified atmosphere packaging of breast fillets can improve lipid stability and may extend shelf life.

Key Words: Storage, Modified Atmosphere, Shelf Life

M96 Characterization and potential human health risks of Shiga toxin-producing *Escherichia coli* isolated from California dairy cattle over one year. L. M. Bollinger*[1], H. S. Hussein[1], M. R. Hall[1], and E. R. Atwill[2], [1]*University of Nevada*, *Reno*, [2]*University of California*, *Davis*.

Worldwide awareness of Shiga toxin-producing *Escherichia coli* (STEC) increased in recent years due to tracing many human illness outbreaks to consumption of foods contaminated with cattle feces. Pathogenic STEC strains produce toxins responsible for causing (Shiga toxin 1 and/or Shiga toxin 2) or increasing (α-hemolysin and/or enterohemorrhagic *E. coli* [EHEC]-hemolysin) the severity of illnesses. These toxins are encoded by stx_1, stx_2, *hlyA*, and EHEC-*hlyA* genes, respectively. Because dairy cattle are STEC reservoirs, they can impose significant health risks to humans. The objective was to examine STEC prevalence in four dairy farms (averaging 712 cows) in California and to assess potential pathogenicity of the isolates. Analysis of 1,268 fecal samples from heifers (n = 261) and cows (n = 1,007) over one year resulted in detection of 33 isolates that belonged to 16 STEC serotypes (O15:H^- [nonmotile], O116:H^-, O125:H20, O127:H19, O128:H20, O136:H10, O136:H12, O136:H19, O136:HUT [untypeable H antigen], O157:H7, O157:H^-, O166:H6, OX13 [new provisional O antigen]:H19, OX13:H20, OUT [untypeable O antigen]:H7, and OUT:H^-) and were lethal to Vero (African green monkey kidney) cells. Of these isolates, 17, 4, and 12 had stx_1, stx_2, or both genes, respectively. Except for one (belonging to the O128:H20 serotype, having both genes, and expressing only stx_2), all isolates expressed these genes. Only one isolate (belonging to the O166:H6 serotype) had and expressed the *hlyA* gene whereas 18 isolates had the EHEC-*hlyA* gene but only five expressed it. Of the 16 serotypes, three (O157:H7, O157:H^-, and OUT:H^-) cause hemolytic uremic syndrome, two (O15:H^- and OUT:H7) cause other human illnesses, and eight (O125:H20, O127:H19, O128:H20, O136:H10, O136:H19, O166:H6, OX13:H19, and OX13:H20) have not been reported previously in cattle. Because our STEC isolates produced one (n = 18), two (n = 13), or three (n = 2) virulence factors, their pathogenic potential to humans should not be ignored. Our results demonstrate the potential health risks of O157 and non-O157 STEC isolates from dairy cattle origin.

Key Words: Shiga Toxins, *Escherichia coli*, Dairy Cattle

M97 Characterization and potential human health risks of Shiga toxin-producing *Escherichia coli* isolated from feedlot cattle. H. S. Hussein*[1], L. M. Bollinger[1], M. R. Hall[1], S. F. Khaiboullina[1], and E. R Atwill[2], [1]*University of Nevada*, *Reno*, [2]*University of California*, *Davis*.

Since tracing two outbreaks of human illnesses to consumption of beef contaminated with Shiga toxin-producing *Escherichia coli* (STEC) in 1982, the concerns with beef safety have been on the rise. The illnesses included bloody diarrhea, hemorrhagic colitis, and hemolytic uremic syndrome (HUS). The ability of STEC to cause (Shiga toxin 1 and/or Shiga toxin 2) or increase (α-hemolysin and/or enterohemorrhagic *E. coli* [EHEC]-hemolysin) the severity of these illnesses is directly related to production of virulence factors. The genes coding for these factors are stx_1, stx_2, *hlyA*, and EHEC-*hlyA*, respectively. Because beef cattle are STEC reservoirs, they continue to impose significant health risks to humans. The objective was to examine STEC prevalence in four feedlots (ranging from 13,000 to 46,000 Holstein steers) in California and to assess potential pathogenicity of their isolates. To achieve this, 642 fecal samples (approximately 40 samples per feedlot per season) were collected from 321 growing and 321 finishing steers over one year. A total of 21 isolates belonging to 14 STEC serotypes (O86:H19, O114:H2, O125:H19, O127:H19, O136:H12, O136:H^- [nonmotile], O153:H^-, O157:H7, O165:H7, OUT [untypeable O antigen]:H5, OUT:H12, OUT:H20, OUT:H^-, and OUT:HUT [untypeable H antigen]) were detected and were toxic to Vero (African green monkey kidney) cells. Of these isolates, 12, 5, and 4 had stx_1, stx_2, or both genes, respectively. Except for two (belonging to the O157:H7 and O165:H7 serotypes, having both genes, and expressing only stx_2), all isolates expressed these genes. None of the recovered isolates had the *hlyA* gene whereas 14 isolates had the EHEC-*hlyA* gene but only five expressed it. Of the recovered serotypes, two (O157:H7 and OUT:H^-) cause HUS, two (OUT:H12 and OUT:HUT) cause other human illnesses, and seven (O86:H19, O114:H2, O125:H19, O127:H19, O165:H7, OUT:H12, and OUT:H20) have not been reported previously in cattle. The results showed these beef cattle isolates to produce one (n = 14) or two (n = 7) virulence factors and demonstrated the potential health risks of O157 and non-O157 STEC isolates.

Key Words: Beef Cattle, Shiga Toxins, *Escherichia coli*

M98 Prevalence and pre-harvest control factors affecting Shiga toxin-producing *Escherichia coli* in cattle grazing rangeland forages. L. M. Bollinger*[1], H. S. Hussein[1], and E. R. Atwill[2], [1]*University of Nevada*, *Reno*, [2]*University of California*, *Davis*.

Shiga toxin-producing *Escherichia coli* (STEC) caused numerous outbreaks of human illnesses ranging from mild diarrhea to hemolytic uremic syndrome (HUS). Beef cattle are STEC reservoirs and impose health risks to humans through fecal contamination of beef. To minimize this risk, it is essential to identify and implement pre-harvest control measures that decrease fecal shedding of STEC. The objective was to determine effects of pre-harvest factors on STEC prevalence in California cattle grazing rangeland forages. In six cow/calf operations (ranging from 65 to 225 cows), 774 fecal samples (approximately 32 samples per operation per season) were collected from 463 cows, 40 heifers, and 271 calves (16 to 121-d-old) over one year. Prevalence of STEC was higher ($P < 0.05$) for calves and heifer (8.1 and 15%) than for cows (3.7%) and in the winter than in the other seasons (13.6 vs an average of 3.0%). The STEC isolates belonged to 38 serotypes (O1:H2, O5:H^- [nonmotile], O26:H11, O39:H^-, O84:H1, O84:H2, O84:H^-, O86:H2, O96:H19, O111:H16, O111:H^-, O116:H2, O116:H36, O125:H2, O125:H16, O125:H19, O125:H27, O125:H28, O125:H^-, O127:H2, O127:H19, O127:H28, O128:H2, O128:H16, O128:H20, O146:H21, O157:H7, O157:H19, O157:H^-, O158:H16, O158:H19, O158:H28, O166:H2, O166:H6, O166:H20, OUT [untypeable O antigen]:H2, OUT:H19, and OUT:H^-). Of these, 10 (O5:H^-, O26:H11, O84:H^-, O111:H^-, O125:H^-, O128:H2, O157:H7, O157:H^-, OUT:H2, and OUT:H^-) cause HUS, three (O1:H2, O84:H2, and

OUT:H19) cause other illnesses, and 19 have not been reported previously in cattle. Lower ($P < 0.05$) STEC prevalence was associated with animal factors such as decreasing stock density (≤ 1.0 cow/acre), early separation of calves (≤ 6 mo), increasing the size of calving pasture (> 120 acres), and absence of diarrhetic calves 2 to 4 mo prior to fecal sampling. Of the dietary factors tested (e.g., supplementation of pregnant cows with alfalfa, molasses, or selenium), only molasses decreased ($P < 0.05$) STEC prevalence from 6.7 to 0%. Thus, decreasing fecal shedding of STEC by range cattle appears possible by altering management practices.

Key Words: Shiga Toxins, *Escherichia coli*, Beef Cattle

Forages and Pastures - Livestock and Poultry: Forage Quality and Nutritive Value

M99 Mineral concentrations of tropical forages in the regions of San Vicente de Caguan, Colombia. R. Vargas, L. R. McDowell*, R. Van Alstyne, and N. S. Wilkinson, *University of Florida*, *Gainesville*.

In the San Vicente Zone of Colombia, South America, south of Llanos Orientales, beef cattle have been dying of a disease linked to nutrient deficiencies. Botulism is the major disease linked to the bovine mortality with 4000 deaths from 1995 to 2003. Animals were observed with abnormal appetite (pica) consuming old bones and bones from decaying carcasses. Mineral deficiencies, particularly P, are the suspected reason for the large consumption of bone. An experiment was designed to determine the mineral status of forages in relation to cattle requirements from eight ranches in the region of San Vicente de Caguan, Colombia. Forage samples (64) were collected equally between the rainy (September–December, 2002) and dry (January–March, 2003) seasons. The major forage was Brachiaria decumbens, with other important grasses including Axonopus pursuii, Tachypogan vestitus and Leersia hexandra. Samples were collected, dried, ground and analyzed by standardized procedures for 12 minerals. Significant ($P<0.05$) forage concentrations were found among farms and there were season differences ($P<0.05$) for K, Co and Zn. Potassium and Co were higher in the rainy season and Zn higher in the dry season. Forage macromineral concentrations (%) for rainy and dry seasons were as follows: Ca (0.18, 0.15); P (0.07, 0.07); Na (0.04, 0.04); K (5.5, 1.3); Mg (0.22, 0.14) and for trace minerals (ppm); Cu (6.7, 8.3); Co (0.09, 0.34); Se (0.07, 0.08); Zn (15, 34); Fe (108, 136); Mn (173, 238); Mo (0.08, 0.08). In relation to beef cattle requirements almost all samples were severely deficient in P, Na and Ca. Cobalt was deficient only in the rainy season. Potassium, Mg, Fe and Mn were not deficient and Mo was not in excess. The minerals most deficient and most likely causing death and botulism are P, Na, Ca, Se, Cu and Zn.

Key Words: Cattle, Botulism, Minerals

M100 Effect of selenium fertilizer on forage selenium content. S. J. Filley*, A. Peters, and C. Bouska, *Oregon State University*, *Corvallis*.

The objective of this experiment was to determine the effect of source and rate of Se applied as fertilizer on forage Se content. Low-Se pasture plots (three per treatment) containing perennial ryegrass (*Lolium perenne*) and subterranean clover (*Trifolium subterranean*) were assigned randomly to treatments of 0.0 (control), 0.6, 1.1, and 2.2 kg/ha sodium selenite, and 0.6 kg/ha sodium selenate. Plots were protected from grazing by use of electric fence, and total forage DM production and Se concentrations were measured after the spring growing season in year one. Pastures were grazed by sheep over the fall growing season, but then protected from spring grazing to enable sampling of residual forage Se concentrations during year two. Differences among treatments within year were analyzed with a Kruskal-Wallis non-parametric test. Welch's t-tests were conducted for each two-way comparison between the four active treatments and the control. The significance level was adjusted using a Bonferroni correction. Fertilization with 0.6 kg/ha selenate provided the highest ($P<0.01$) average forage Se content in year one (8.44±0.08 mg/kg). Plots treated with 0.6 and 2.2 kg/ha selenite contained greater ($P<0.01$) forage Se content (1.17±0.05 and 4.24±0.35 mg/kg, respectively) than control (0.09±0.06 mg/kg), whereas the 1.1 kg/ha selenite treatment only tended ($P=0.06$) to increase forage Se content (3.11±0.79 mg/kg). The second year after treatment, forage Se concentrations for the 0.6 kg/ha selenate and 2.2 kg/ha selenite application (0.43±0.04 mg/kg and 0.51±0.06 mg/kg, respectively) were greater ($P=0.04$ and $P=0.01$, respectively) than control (0.06±0.03 mg/kg). Fertilization with Se had no effect ($P=0.37$) on forage yield during year one. These data suggest that selenite and selenate fertilization increases forage Se concentrations for up to two years, and is a cost-effective method of supplying Se for grazing livestock.

Key Words: Selenium, Fertilization, Forage

M101 Effect of organic and chemical nitrogen fertilization on mulberry (*Morus alba*) fodder production. J. A. Elizondo Salazar* and C. Boschini Figueroa, *Estación Experimental Alfredo Volio Mata. Facultad de Ciencias Agroalimentarias*, *Universidad de Costa Rica, Costa Rica.*

Feeding woody plants as a supplement in dairy and beef systems has been widely used in Costa Rica and many other areas of the world. However, high fodder yields and adequate crude protein levels require application of large doses of chemical N, increasing production costs and pollution risk. To reduce cost, producers are utilizing organic fertilizers from manure without knowing the impact on production. For this reason, a study was conducted to evaluate the application of 150 kg/ha per yr of N from 2 organic fertilizers: vermicompost and compost; and from 1 chemical fertilizer: ammonium nitrate (33.5% N) on fodder production. A 12-yr-old mulberry plantation planted at spacings 0.9 × 0.40 m (27,777 plants/ha) was utilized in a randomized block design with 4 treatments: 2 organic fertilizers, ammonium nitrate, and a control (no fertilizer). All plots were uniformly pruned at 0.6 m from the ground at the beginning of the trial. Fertilizers were applied in 2 doses during the rainy season. For a 365-d period, plants were pruned consecutively every 90 d. Leaves and stems were separated and analyzed for dry matter and crude protein content. Dry matter production was 23% higher for the chemical fertilizer. Crude protein content was also significantly higher for the chemical nitrogen, while dry matter content was lower. The amount of N in the soil was sufficiently high for the control treatment to yield fodder and crude protein levels similar to those of organic fertilizers.

Table 1.

Item	Treatment					
	Vermi-compost	Compost	Chemical	Control	SEM	*P*
Dry matter, kg/ha/yr						
Leaves	12,603.7[b]	12,943.3[b]	15,153.0[a]	12,601.3[b]	545.9	0.001
Stalk	8,807.3[b]	8,637.7[b]	11,413.3[a]	8,874.7[b]	601.4	0.001
Total	21,410.7[b]	21,581.3[b]	26,556.7[a]	21,476.3[b]	1,039.0	0.010
Dry matter, %						
Leaves	22.67[a]	22.58[a]	21.50[b]	22.67[a]	0.28	0.010
Stalk	23.33	23.08	22.17	23.50	0.50	NS
Total	22.83[a]	22.75[a]	21.67[b]	22.92[a]	0.29	0.001
Crude protein, %						
Leaves	15.67[b]	15.33[b]	17.25[a]	16.00[b]	0.33	0.001
Stalk	5.67	5.33	6.25	5.50	0.29	NS
Total	11.67[b]	11.50[b]	12.58[a]	11.67[b]	0.25	0.010

Key Words: Morus alba, Organic Fertilizer, Fodder Production

M102 The economics of liming coastal dairy pastures. T. W. Downing* and J. Hart, *Oregon State University*, *Corvallis*.

Soil acidity is a universal problem for crop production in high rainfall environments. Research has shown for many crops that low soil pH can significantly reduce plant productivity. Consequently, applying lime to increase soil pH is a common practice. Coastal Oregon pasture managers continue to question the economic returns and benefit from lime application even with low soil pH values. The objectives of this study were to: 1) measure soil pH change from different rates and method of lime application in coastal-pastures, 2) calculate the economic returns of lime application by measuring increases in pasture productivity and feed value. Twenty four plots measuring 1.5m x 6m were planted in the fall in perennial ryegrass. Lime treatment levels were at 2.4, 4.8 and 9.6 tons per hectare. Each treatment was replicated three times in both the incorporated and top dress blocks. Three control plots were also included in each lime treatment block. For two years, plots were harvested 6 times annually, yield data was recorded and samples of each treatment were collected and analyzed for protein, TDN, NDF, Ca, P and other trace minerals. Soil samples were taken from each treatment block and rate at the end of each growing season. Data were statistically analyzed to understand any differences in yield, treatment method, treatment rate, and any interactions. Lime increased soil pH and extractable Ca ($P<0.01$). No interaction between method and rate was measured. Method of application did not influence yield. Liming had no significant effect on forage quality parameters measured. Lime treatments increased soil pH from 5.1 up to 6 in the highest lime treatments ($P<0.01$). However, the total increase was only around 500 kg of forage per hectare per year. The increased forage production would take four years to cover the costs of lime. This project has improved our understanding of the economic returns of liming coastal pastures. Coastal soils that are high in organic matter and low in pH appear to respond differently to lime application than other acidic soils reported in the literature.

Key Words: Acidic Soils, Liming, Economics of Liming

M103 Nitrogen fertilization and weather influence winter yield and nutritive value of stockpiled bermudagrass. J. A. Guretzky*, J. B. Ball, B. J. Cook, S. L. Norton, and F. J. Motal, *The Samuel Roberts Noble Foundation, Inc.*, *Ardmore, OK*.

Management strategies that extend the grazing season and reduce hay demands may improve the profitability of cow-calf operations. Our objective was to evaluate the yield and nutritive value of fall stockpiled bermudagrass (*Cynodon dactylon* (L.) Pers.) in response to N fertilization rate, N application time, and winter harvest date. Research was conducted on a fine, sandy loam soil near Burneyville, OK from 2000 to 2003. Nitrogen rates included 0, 56, 112, and 168 kg ha^{-1} applied 15 Aug, 1 Sep, 15 Sep, 1 Oct, and 15 Oct. Dry matter yield was measured ten days after the first killing frost. Samples were collected every 15 days from 6 Dec through 20 Feb to evaluate CP and TDN. The experiment design was a split-plot with repeated measures over years and harvest dates. Nitrogen application dates served as whole plots and N rates as subplots. Forage yields were 123, 3735, 5541, and 4021 kg ha^{-1} in 2000, 2001, 2002, and 2003, respectively. In the latter three years, N affected yields in a quadratic manner. Yields averaged 3864, 4480, 4645, and 4738 kg ha^{-1} with 0, 56, 112, and 168 kg N ha^{-1}. Although interactions of year, N rate, application date, and harvest date occurred, nutritive value from 2001 to 2003 was largely affected by N rate. Of 17 winter harvest date-year combinations, CP increased in a linear or quadratic manner 16 times as N rate increased and exceeded 71 g kg^{-1} DM on most harvest dates with 112 kg N ha^{-1}. Total digestible nutrients increased from 565, 555, and 582 g kg^{-1} DM at 0 kg N ha^{-1} to 571, 563, and 585 g kg^{-1} DM at 168 kg N ha^{-1} in 2001, 2002, and 2003, respectively. Drought limited the accumulation of fall stockpiled bermudagrass and inflated nutritive values in 2000. As a consequence, N fertilization is not recommended during dry falls. In years of favorable fall precipitation, 112 kg N ha^{-1} will produce 4645 kg ha^{-1} of forage with CP and TDN concentrations that meet the nutrient requirements of beef cows during the middle third of pregnancy. Nitrogen application date and winter harvest date had minimal effects on yield and nutritive value.

Key Words: Forage Management, Beef Cow Nutrition, Forage Quality

M104 Macro and micro mineral concentrations of annual cool season pasture forages in north Florida–a four year summary. R. O. Myer*, G. Chelliah, J. N. Carter, L. R. McDowell, N. S. Wilkinson, and A. R. Blount, *University of Florida*, *Gainesville*.

Concentrations of selected macro (Ca, P, Na, K, Mg) and trace (Cu, Fe, Zn, Mn, Co, Se) minerals were determined from annual pasture forages over four winter-spring grazing seasons (2001-2005). Forage samples were taken from eight experimental pastures per year used in beef cattle grazing studies. Two, 2-yr experiments were done; animal and pasture data were reported previously. Each experiment was of a similar 2×2 design comparing clean tilled vs. sod-seeded pastures with two different forage combinations (Exp. 1, rye + oats vs. rye + oats + ryegrass (Lolium multiflorum L.); Exp. 2, oats + ryegrass vs. ryegrass only). Pastures were planted in Oct or Nov, and grazed (and sampled) starting Nov, Dec, Jan or Feb and ending Apr or May. Overall, forage type or pasture planting method had little effect on pasture forage mineral concentrations except for Zn ($P<0.01$). Year effected ($P<0.01$) forage P, K, Mg, Cu, Fe and Zn. Month during the grazing season had a large effect ($P<0.01$) on P, K, Fe, Mn and a smaller effect ($P<0.05$) on Mg, Cu, Zn and Co concentrations. Overall pasture forage mean

concentrations and S.D. for macro minerals (% of DM) were Ca, 0.31 ± 0.05; P, 0.38 ± 0.03; Na, 0.035 ± 0.005; K, 2.9 ± 0.2; and Mg, 0.21 ± 0.03; and for micro minerals (ppm of DM) were Cu, 5.7 ± 0.7; Fe, 78 ± 14; Zn, 40 ± 5; Mn, 110 ± 18; Co, 0.06 ± 0.04; Se, 0.05 ± 0.01. Results indicate that year and month within year can influence concentrations of various macro and micro minerals of annual cool season pastures in the southeastern USA. Of the minerals evaluated, Na, Cu, Co and Se would be deficient for beef cattle.

Key Words: Minerals, Forages, Pastures

M105 Nutritive value of low DCAD timothy forage produced with Cl fertilization. G. F. Tremblay*[1], S. Pelletier[1], G. Bélanger[1], P. Seguin[2], R. Drapeau[1], and G. Allard[3], [1]*Agriculture and Agri-Food Canada*, *Québec, QC, Canada*, [2]*McGill University*, *Ste-Anne-de-Bellevue, QC, Canada*, [3]*Université Laval*, *Québec, QC, Canada*.

To prevent hypocalcaemia, dairy producers feed dry cows a ration with a low dietary cation-anion difference [**DCAD**=(Na+K)-(Cl+S)]. Because anionic salts used to decrease the ration DCAD may reduce DM intake, low DCAD forages should be fed to dry cows. We have shown that Cl fertilization decreased the DCAD of timothy forage by as much as 266 meq/kg DM with no effect on DM yield. Here, we assessed the effect of Cl fertilization on the nutritive value of timothy forage at four locations in Québec, Canada, in 2003 and 2004. Ten fertilizer treatments were applied (0, 80, 160, and 240 kg Cl/ha as $CaCl_2$; 160 kg Cl/ha as NH_4Cl; all combined with 70 or 140 kg N/ha) in a split application: 60% in spring and 40% after the first harvest. A split-split-plot design was used with locations assigned to main plots, fertilizer treatments to sub-plots, and harvests to sub-sub-plots. Concentrations of crude proteins (**CP**) and neutral detergent fibers (**NDF**), in vitro true DM digestibility (**IVTDMD**), and NDF digestibility (**dNDF**) were measured in forage samples. Average values across harvests and locations were used because of no significant interactions with Cl fertilization. At the lowest N fertilization rate (70 kg N/ha), Cl fertilization had no effect on the four measured parameters of nutritive value. At the highest N rate (140 kg N/ha), increasing Cl fertilization did not affect CP concentration but it increased NDF concentration (+10 g/kg DM) and decreased IVTDMD (-10 g/kg) and dNDF (-12 g/kg NDF); this effect, however, was small and would most likely be of no biological importance. Decreasing DCAD with Cl fertilization would not significantly affect the timothy forage nutritive value.

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Key Words: Grass Forage, Milk Fever, Chloride Fertilizer

M106 Nutritive quality of a species-rich, extensively managed pasture exposed to elevated ozone in a free-air fumigation system. J. C. Lin*[1], K. Nadarajah[1], M. Volk[2], R. B. Muntifering[1], and J. Fuhrer[2], [1]*Auburn University*, *Auburn, AL*, [2]*Swiss Federal Research Station for Agroecology and Agriculture*, *Zurich, Switzerland*.

Effects of tropospheric ozone (O_3) on nutritive quality of O_3-sensitive species grown as monocultures or in simple mixed cultures are well established, but its effects on complex, species-rich plant communities are unknown. A 5-year field experiment was conducted near Le Mouret, Switzerland to investigate the effects of exposure to elevated O_3 on nutritive quality of an extensively managed, semi-natural pasture containing a diverse mixture of grasses, legumes and forbs. Using a free-air fumigation system, six circular plots (7-m diam.) were randomly exposed to either ambient air (control) or to air containing approximately 1.5 × ambient O_3 concentration (n = 3). Six subplots (0.5 m^2) in each ring were harvested each year in mid-June, early August and late October. Compared with controls, annual biomass yields from elevated-O_3 plots decreased by 23% over the 5-yr period. Except for year and seasonal differences, there was no effect of elevated O_3 on forage N concentration. However, there were differences ($P < 0.001$) between control and O_3-enriched plots in forage concentrations of NDF and ADF, but not lignin, and in relative feed value (RFV). Changes in proportions of grasses, legumes and forbs followed a similar pattern within treatments, but the magnitude of these changes was greater ($P < 0.05$) for the elevated-O_3 than control treatment. Between the first harvest (spring, 1999) and spring of 2003, forbs increased ($P < 0.05$) from 23.4 to 36.2%, grasses decreased ($P < 0.001$) from 67.6 to 60.5%, and legumes decreased ($P < 0.01$) from 8.9 to 3.3% of total plant DM within the O_3-enriched plots. Compared with control plots, forage from O_3-enriched plots had lower concentrations of NDF (46.9 vs. 49.9%) and ADF (27.2 vs. 28.2%), and higher RFV (136 vs. 126, by reference to a mature legume forage of RFV = 100). Unlike earlier reports of negative effects of elevated O_3 on nutritive quality resulting from altered leaf chemistry in individual plant species, this is the first report of altered nutritive quality associated with O_3-driven shifts in proportions of plant functional groups in a complex, species-rich pasture.

Key Words: Pasture, Nutritive Quality, Ozone

M107 Evaluation of forage quality, grazing capacity and intake of cool season grasses. C. I. Ward*[1] and H. A. Lardner[1,2], [1]*University of Saskatchewan*, *Saskatoon, Canada*, [2]*Western Beef Development Center*, *Humboldt, Saskatchewan, Canada*.

An experiment was conducted to evaluate the effects of cool season grass varieties on forage quality, animal grazing days (AGD), total beef production (TBP) per hectare and dry matter intake (DMI) of yearling cross-bred steers. Grass varieties were crested wheatgrass (CWG) (*Agropyron cristatum*) cv. 'AC Goliath', meadow bromegrass (MBG) (*Bromus riparius*) cv. 'Paddock', smooth bromegrass (SBG) (*B. inermis*) cv. 'Carlton', hybrid bromegrass (HBG) (*B. riparius* X *B. inermis*) cv. 'AC Knowles' and tall fescue (TF) (*Festuca arundinacea*) cv. 'Courtenay'. A long established CWG stand acted as a control pasture. Each variety was replicated (n=2) in paddocks measuring 0.8 ha. Forage samples clipped at start, end and mid-grazing period were analyzed for neutral detergent fiber (NDF), acid detergent fiber (ADF), crude protein (CP) and *in vitro* organic matter digestibility (IVOMD). In 2004 and 2005, all paddocks were grazed once (averaged 26 and 32 days of grazing, respectively) except in 2004 when the TF and CWG control paddocks were not grazed. In 2006, regrowth allowed for two grazing periods on all paddocks (averaged 35 and 16 days of grazing, respectively) except for the TF and CWG control paddocks, which were only grazed once. MBG and CWG control paddocks had the lowest CP content at the start of grazing ($P<0.05$). CWG paddocks had greater NDF and ADF content compared to TF and MBG ($P<0.05$). The CWG control paddocks had the lowest AGD in 2005 and 2006 while TF had the greatest AGD ($P<0.05$). Total beef production per hectare was similar among grass varieties ($P>0.05$). Results indicate

that new grass varieties have greater potential forage quality and animal production compared to long established CWG pastures. Dry matter intake was measured using the *n*-alkane technique in both grazing periods of 2006.

Key Words: Forage Quality, Beef Production, Intake

M108 Productivity and nutritive quality of dallisgrass (*Paspalum dilatatum*) as influenced by rate of fertilization with poultry litter or commercial fertilizer. E. J. Bungenstab*, J. C. Lin, J. L. Holliman, A. C. Pereira, and R. B. Muntifering, *Auburn University*, *Auburn, AL*.

Dallisgrass (*Paspalum dilatatum*) is well adapted to the clayey and loamy soils and warm, humid climate of the Black Belt physiographic region of the southeastern US, but poor soil fertility can be a major limitation to forage production in the region. In 2006, an existing pasture dominated by dallisgrass was clipped to a height of 10 cm on July 17 and subdivided into 48 cells of 9.3 m^2 each. Each cell received the equivalent of 34 (34N), 67 (67N), 101 (101N) or 134 (134N) kg N/ha from poultry litter (PL; 2.75% N, DM basis) or commercial fertilizer (CF; 35% N as NH_4NO_3), and forage regrowth from each was clipped on August 21 and then again on September 25 (n = 6 cells/treatment). Forage DM yield was not different between CF and PL treatments in the August harvest (836 and 763 kg DM/ha, respectively), but was greater ($P < 0.001$) for CF than PL treatments in the September harvest (436 vs. 346 kg DM/ha). Yields of CF-amended forage from both harvests were lower for the 101N rate than other rates of CF application, whereas yield of PL-amended forage was greater for the 134N rate in August but not different among rates of PL application in September (fertilizer source × rate interaction, $P < 0.05$). Forage concentration of CP was greater ($P < 0.001$) for CF than PL treatments in August (10.4 vs. 9.3%) and September (10.6 vs. 9.3%), and increased in both treatments at both harvests with increasing rates of N application. Forage concentrations of cell-wall constituents were not different between CF and PL treatments, but forage amended with CF at the 134N rate had lower concentrations of NDF ($P < 0.04$) and ADF ($P < 0.05$) in August than did forage amended with CF at the 34N rate (67.5 vs. 70.0% and 33.3 vs. 34.7%, respectively). Forage amended with PL at the 34N rate had higher ($P < 0.02$) concentration of ADF (34.3%) in September than did forage amended with PL at the 67N (32.9%) and 134N (33.0%) rates. Results indicate that poultry litter offers potential as a cost-effective alternative to commercial fertilizer for supporting productivity of dallisgrass on sub-fertile soils.

Key Words: Dallisgrass, Nutritive Quality, Poultry Litter

M109 Effect of clipping on the stolon elongation rate and stolon survival of cultivars *Chloris gayana* Kunth in conditions of salinity. M. V. Cornacchione*[1], H. E. Pérez[2], and A. F. Fumagalli[1,3], [1]*Instituto Nacional de Tecnología Agropecuaria*, *Santiago del Estero, Argentina*, [2]*Instituto Nacional de Tecnología Agropecuaria*, *Leales, Tucumán, Argentina*, [3]*Universidad Nacional de Santiago del Estero*, *Santiago del Estero, Argentina*.

The objective of this trial was to evaluate the effect of clipping on stolon elongation rate (SER) and stolon survival of four cultivars of *Chloris gayana* Kunth, in a moderate saline soil (from 0 to 60 cm depth, the avg. ECe=9.6 dS/m and avg. pH=7.95). Three tetraploid (Callide, Boma and experimental line; EL, INTA-PEMAN) and one diploid cultivar (Topcut) were planted in February of 2005. The initial stolon density (n°/m^2) was evaluated in a completely randomized block design with four replicates. The elongation stolon (L=cm) and stolon survival were measured on 40 stolons identified for cultivar when 20 stolon were clipped every seven weeks to approximately 12 cm of this base including to the first knot. The stolon elongation rate was calculated as SER= L-12/days among cuts. Stolon survival was calculated for each cultivar as follow: %S=(n° of live stolons/20)×100. Initial stolon density was significantly greater in EL ($P<0.01$; 57±12 stolons/m^2), intermediate in Boma and Callide (46±12 and 45±9 stolons/m^2), and lowest in Topcut (24±9 stolons/m^2). EL tended to have greater SER with regards to Topcut ($P=0.06$; 0.50±0.26 vs. 0.15±0.10 cm/d for EL and Topcut respectively). The SER of Callide and Boma were intermediate and did not differ with the previous ones. The % of S in Callide and Topcut was affected negatively by clipping treatment ($P<0.05$; clipping: 27.5% and non-clipping: 67.5%). All cultivars under clipping had low %S (avg. 30%). However clipping affected Callide and Topcut ($P<0.05$) than LE and Boma. In conclusion, in conditions of intermediate salinity, the tetraploid cultivars showed better performance due to: greater initial density of stolon and capacity of growth under clipping (principally EL) with respect to Topcut. The survival stolons in Topcut and Callide was better when they were not cut.

Key Words: *Chloris gayana*, Saline Soil, Stolon Elongation

M110 The effect of wide swathing on wilting times and nutritive value of alfalfa haylage. L. Kung, Jr., E. C. Stough*, E. E. McDonell, R. J. Schmidt, M. W. Hofherr, L. J. Reich, and C. M. Klingerman, *University of Delaware*, *Newark*.

At three separate cuttings, alfalfa (*Medicago sativa*) from a single field was mowed with a John Deere 946 mower-conditioner (4 m cut width) to leave narrow swaths (NS) with widths between 1.2 to 1.52 m (4-5 ft) and wide swaths (WS) ranging 2.44 to 2.74 m (8-9 ft). Samples were collected from windrows and DM was monitored during wilting until a target of 43-45% DM was obtained. Forage from random windrows (n = 4 to 6 depending on cutting) was then chopped and ensiled in replicated vacuum sealed bags for about 65 d. Data were analyzed for the main effects of swath width (NS vs. WS), cutting (1 to 3) and swath width × cutting interaction. There was no swath width × cutting interaction for any parameter tested. Over all cuttings, the resulting silage DM was not different between NS (43.8%) and WS (44.9%). However, wide swathing greatly reduced the time of wilting before making silage. The hours of wilting time for NS and WS at cuttings 1, 2 and 3 were 50 vs. 29, 54 vs. 28, and 25 vs. 6, respectively. On average, wide swathed alfalfa was chopped 22 h earlier than narrow swathed alfalfa. At the time of ensiling, WS had more water soluble carbohydrates (5.1%, $P < 0.05$) than did NS (3.7%). Silages made from WS had a lower pH (4.58, $P < 0.05$) than did NS (4.66) but swath width did not affect fermentation end products (lactic acid, acetic acid and ethanol). Silage made from NS had more NH3-N (0.26%, $P < 0.05$) than WS (0.21%). Swath width did not affect the concentration of ash, NDF or the digestibility of NDF but it lowered the N content of the resulting silage (NS = 3.45%, WS = 3.23%, $P < 0.05$). For the main effect of cutting, the concentrations of N and water soluble carbohydrates decreased and the digestibility of NDF decreased, whereas the concentration of NDF increased with progressive cuttings.

Wide swathing can markedly reduce the time that alfalfa must wilt before it can be chopped for silage but under good conditions, the resulting silage quality was generally not improved.

Key Words: Alfalfa, Swath Width, Wilting

M111 Effects of harvest timing on estimates of rumen degradable protein from alfalfa forages. W. K. Coblentz*[1], G. E. Brink[2], N. P. Martin[2], and D. J. Undersander[3], [1]*US Dairy Forage Research Center*, *Marshfield, WI*, [2]*US Dairy Forage Research Center*, *Madison, WI*, [3]*University of Wisconsin*, *Madison*.

Alfalfa (*Medicago sativa* L.) proteins ingested by dairy cows typically degrade at rapid rates, resulting in low percentages of dietary crude protein (CP) that escape the rumen intact. Our objectives were to determine rumen degradable protein (RDP) for alfalfa managed in a four-harvest system that was clipped on five dates within each harvest. During 2004 and 2005, ″Affinity″ alfalfa was harvested four times (spring, early and late summer, and fall) at Prairie du Sac, WI; within each harvest, plots were clipped initially (d 0) when plants were at least 30 cm tall, but did not exhibit any evidence of buds. Additional sampling dates were scheduled at 5-d intervals for the next 20 d, resulting in a total of five clipping dates (0, 5, 10, 15, and 20 d) within each individual harvest. Forages were evaluated for CP, neutral-detergent soluble CP (NDSCP), and neutral-detergent insoluble CP (NDICP); in addition, RDP and rumen undegradable protein (RUP) were determined by the *Streptomyces griseus* protease method. For 2004, there were no interactions ($P \geq 0.372$) between harvest number and clipping date for any protein component. Crude protein, NDSCP, and RDP declined in a quadratic ($P \leq 0.026$) relationship with clipping dates. A quadratic ($P = 0.002$) pattern also was observed for RUP, but the overall range was small (6.04 to 6.65% of DM); similarly, NDICP exhibited only a quadratic trend ($P = 0.077$) and a small overall range (2.63 to 2.90% of DM). On a percentage of CP basis, RDP declined linearly ($P < 0.001$) from 72.0 to 65.9% of CP during 2004. For 2005, there were interactions ($P \leq 0.020$) of harvest number and clipping date within harvest for all response variables. Although less consistent than in 2004, trends for individual CP pools generally were similar over clipping dates within harvest. Concentrations of RDP (% of CP) declined ($P \leq 0.042$) with clipping date during three of four harvests, but specific polynomial effects varied with harvest number. Overall, RDP (% of CP) declined as alfalfa plants aged, but these responses were due primarily to reduced concentrations of CP within the highly degradable cell-soluble fraction.

Key Words: Alfalfa, Rumen Degradable Protein, Plant Age

M112 Effects of planting density, cultivar and growing day on the dry matter yield and forage quality of Kenaf (*Hibiscus Cannabinus* L.) in the northern area of South Korea. B. W. Kim* and K. I. Sung, *Kangwon National University*, *Chuncheon, Kangwon-Do, South Korea*.

This study was conducted to evaluate the dry matter (DM) yield and forage quality of Kenaf in relation to planting density (10×10 and 10×20 cm^2) and growing days (Day 53, Day 62, Day 73, Day 84, Day 93, Day 104 and Day 115) in the northern area of South Korea from May 20 to September 12, 2005. The experiment was laid out in a split plot design with three replications. The main plots consisted of planting density and growing days with three cultivars of Kenaf as sub-plots; Dowling, Everglade and Tainung. The DM yield increased with maturity in all three cultivars, especially Dowling showed the highest DM yield at each harvest time. The crude protein (CP) contents of all three cultivars decreased with maturity. Especially, the decrease in the CP contents was greater in the early stage than in the late stage. The planting density did not affect the CP contents, even though they are little higher in 10×20 cm^2 compared to 10×10 cm^2. Among cultivars, the higher CP contents were observed in Dowling at each growing day. No difference in the neutral detergent fiber and acid detergent fiber contents was observed in the planting density and cultivars, although the increasing tendency was found with maturity. These results suggest that Kenaf can be a good potential forage crop in the northern area of South Korea, especially Dowling which had the greatest DM yield (29.5 ton/ha) and best forage quality (67.1% NDF and 55.8 % ADF) when harvested on Day 104 at 10×20 cm^2 planting density.

Key Words: Kenaf, Planting Density, Forage Quality

M113 The effect of cutting height on yield and quality of alfalfa/reed canarygrass in northern New York. E. D. Thomas, C. S. Ballard*, K. W. Cotanch, H. M. Wolford, and S. A. Flis, *W.H. Miner Agricultural Research Institute*, *Chazy, NY*.

Reducing cutting height when harvesting alfalfa has been shown to increase yield, however forage quality may be compromised by inclusion of more lignified stem material and soil contamination. The objective of this study was to evalulate forage quality and yield of alfalfa/reed canarygrass harvested at 5 and 10 cm. A 2nd year alfalfa/reed canarygrass stand was divided into four plots. Three 61×91 cm areas within each plot were selected randomly for hand–harvest (**HH**) at 5 cm. The HH forage was composited within plot and separated by species to determine sward composition. To simulate 10 cm cutting height, 5 cm was cut from stem of all plants after separation. Each species and removed stem were weighed, dried and ground for analysis. Forage yield and quality were calculated based on sward composition, analysis of species and removed stem for each cutting. From the same field plots, strips within plot were randomly assigned to a theoretical cutting height of 5 and 10 cm and mechanically harvested (**MH**). Actual cutting height was determined by measuring stubble at 15 random locations within each strip. Yield was estimated and chopped forages were dried and ground for analysis. All samples were analyzed for NDF, ADF, lignin, ash, in vitro 24–h DM and NDF digestibility. Procedures were followed for three consecutive cuttings and data were analyzed as a randomized block. The percent alfalfa in the sward was higher in the 2nd and 3rd (74 and 70%) compared to the 1st cutting (42%). Dry matter yield was higher for HH alfalfa/grass at 5 versus 10 cm ($P<0.01$). The 10 cm HH alfalfa/grass was higher in CP and DMd and lower in NDF, ADF and lignin (%DM) compared to the 5 cm ($P<0.05$). Average actual cutting height for MH forage was 8 and 11 cm for 5 versus 10 cm ($P<0.001$). The MH alfalfa/grass had similar numerical differences as the HH for all parameters except ash which tended to be lower in forages MH at 10 versus 5 cm (8.6 and 8.3 %DM, respectively; $P=0.06$), indicating an increase in foreign material obtained during MH. Overall, increases in forage quality were offset by lower yields when alfalfa/grass was harvested at 10 versus 5 cm.

Key Words: Alfalfa, Cutting Height, Forage Quality

M114 Lineweaver-Burk data transformation to evaluate interaction between nutrients in fertilization of tropical forages. H. J. Fernandes[1,4], R. P. Lana[2], C. E. S. Baroni[2], L. M. Paiva[1,4], and J. C Souza*[3,5], [1]*University of Mato Grosso do Sul*, *Brazil*, [2]*Federal University of Vicosa*, *Brazil*, [3]*Parana Federal Univeristy*, *Palotina, PR Brazil*, [4]*Scholarship of FUNDECT*, *Campo Grande, MS, Brazil*, [5]*University of Missouri*, *Columbia*.

This study evaluated the use of a Lineweaver-Burk data transformation to evaluate the effect of potassium (K) fertilization and the productive response to nitrogen (N) fertilization. Forty observations of the Panicum, Cyndom and Penisetum genera in Brazil were obtained from three published studies. A Lineweaver-Burk transformation was used to predict the maximum dry forage mass production (RESPmax) and the amount of nutrient needed to reach half maximum response (NUTR50). The model adequacy was evaluated by the coefficient of determination (R2) and the simultaneous test of the intercept and slope. In all equations, this test accepted the null hypothesis (P>0.10), and the R2 were greater than 0.80. When another limiting nutrient is supplied at same time as the N, the capacity of the forage to convert N in dry matter is increased (and RESPmax too). The differences between the forages may cause differences in NUTR50 responses. When the NUTR50 did not change, the marginal efficiency (kg increase in DM production / Kg of N) increased at all rates of N fertilization. A decrease in the NUTR50 indicates an increase in the efficiency of use of N at small rates of fertilization. When the rates of K fertilization increase an increase in NUTR50 resulted for Cynodom and a decrease in NUTR50 (until 234 kg/ha) result for the Panicum, with an increase in NUTR50 at higher levels. The NUTR50 was not altered in the Pennisetum. It's possible to use the Lineweaver-Burk transformation to evaluate the interaction between the K fertilization and the response of the tropical forages to the N fertilization. The metabolic differences between genera cause different responses at the interaction between nutrients.

Key Words: Mathematical Models, Nutrient Interaction, Tropical Forages

M115 Lineweaver-Burk data transformation to evaluate the production of tropical forages. H. J. Fernandes[1,5], R. P. Lana[2], C. E. S. Baroni[2], L. M. Paiva[1,5], and J. C. Souza*[3,4], [1]*State University of Mato Grosso do Sul*, *Brazil*, [2]*Federal University of Vicosa*, *Brazil*, [3]*Parana Federal University*, *Brazil*, [4]*University of Missouri*, *Columbia*, [5]*FUNDECT*, *Campo Grande, MS, Brazil*.

This study evaluated the use of the Lineweaver-Burk transformation to estimate the kinetic parameters of growth and the responses of forages to nitrogen (N) fertilization. Data included 43 observations of the principal genera of forages used in Brazil (Brachiaria, Panicum, Cyndom and Penisetum) obtained from published studies considered a random study effect. Linear regressions of the reciprocal of the each 'genus' plant responses (Y) as a function of the reciprocal of N fertilization (X) were developed as the model: $1/Y = a + b\ (1/X)$. The maxima of dry forage mass production were obtained by the reciprocal of the intercept (RESPmax=1/a) and the amount of nutrients needed to reach half maximum response (NUTR50), by dividing the coefficient of the linear regression by the intercept (b/a). The R2 of model of the equations to the genera Brachiaria, Panicum, Cyndom e Penisetum were 0.756, 0.865, 0.994 and 0.703, respectively. Marginal responses of the forages decreased as the N rates increased. This behavior can be explained by saturation of the enzymatic systems. The Penisetum genus had a linear response until the maximum rate of N each (400 Kg N/ha/year). In this case, the maximum rate of fertilization was less than that necessary to reach RESPmax. The kinetics parameters estimated for Brachiaria, Panicum,Cyndom and Penisetum were 8.04, 118.3, 25.3 and 80.8 ton DM/ha/year (RESPmax); and 30.5, 380.8, 105.6 and 176.8 kg N/ha/year (NUTR50). The lower the NUTR50, they greater is slopes of response and the greater the responses to small rates of N. The Lineweaver-Burk transformation efficiently explained the kinetics parameters of growing plant. The Brachiaria genus had the greatest response to small rates of N fertilization and the Penisetum had the capacity to respond at high rates.

Key Words: Mathematical Models, Forage, Fertilization

M116 Effect of planting date on starch accumulation of whole crop barley. L. E. McKeown*[1], M. A. Bal[1], M. Oba[1], and V. S. Baron[2], [1]*University of Alberta*, *Edmonton, AB, Canada*, [2]*Agriculture and Agri-Food Canada*, *Lacombe, AB, Canada*.

The objective of this study was to evaluate effect of planting date on rate of starch accumulation and free sugar concentration of whole-plant barley (*Hordeum vulgare*). Two barley varieties (AC Lacombe and Vivar) were planted on either May 5, 2005 (BM) or June 7, 2005 (BJ). Samples of whole plants (n=6) were collected twice weekly after the plant reached the heading stage, until the harvest at late dough stage. Samples were collected on July 5, 8, 12, 15, 19, and 22 for BM and July 26, 29, August 2, 5, 9, 12, 16, 19, and 23 for BJ. The BM took 62 days to reach the heading stage, which was longer than BJ that only took 50 days. However, the period from heading to harvest was shorter for BM (18 d) compared to BJ (29 d). For both BM and BJ, starch concentration increased over time and sugar concentration decreased over time. The final starch concentration of BM at late dough stage was 29.5 and 27.9% for AC Lacombe and Vivar, respectively, and that of BJ was 25.4 and 22.9% for AC Lacombe and Vivar, respectively. Free glucose concentration for BM and BJ were 1.3 and 1.6%, respectively for AC Lacombe, and 1.8 and 1.0% for Vivar. Greater final starch concentration for BM, compared to BJ, might be attributed to lower average temperature throughout the growing period of BM, when compared to the relatively higher average temperature throughout the growing period of BJ. It was also noted that rate of starch accumulation of whole crop barley is decreased regardless of planting date when the daily mean temperature deviated greatly from 15°C. These observations indicate that the ambient temperature during the growing season can affect starch concentration of whole crop barley. Planting dates of barley can alter its growing environment, and affect rate of starch accumulation and its final concentration. Altering planting date may allow for increased management options to harvest whole-crop barley with greater starch concentration, decreasing the amount of supplemental grains fed in dairy diets.

Key Words: Planting Date, Starch, Whole Crop Barley

M117 Seed quality effects on yield, stover nutritional value, and maize grain. C. Perez-Mendoza[1], M. R. Tovar-Gomez*[2], G. Garcia-Santos[1], A. Hernandez-Livera[1], and A. Carballo-Carballo[1], [1]*Colegio de Postgraduados*, *Texcoco, State Mexico, Mexico*, [2]*INIFAP-CEVAMEX*, *Texcoco, State Mexico, Mexico*.

The objective of this study was to evaluate the effect of seed quality on yield, nutritional value of stover and maize (Zea mays L.) grain.

The research was done in 2002 in the Texcoco and Zumpango, State of Mexico and consisted of three phases: 1) seed physical quality and its characterization by form, size and weight was evaluated (flat, large, and medium), 2) seed physiological quality was determined in a microtunnel and 3) yield and nutritional value of maize harvested at physiological maturity were evaluated. Experiments were established using a randomized block design with four replications and a factorial array of treatments. Nine varieties of maize with forage potential were used to study: weight per thousand seeds (W1000S); seed length (LS), width (WS) and thickness (TS); velocity of emergence (VE); dry weight aerial part (DWAP); stover yields (SY) and grain (GY); stover protein (CPS) and grain starch (ST). Significant differences ($P<0.001$) were observed among varieties for all the evaluated parameters; location had a significant effect on SY, GY and ST. Seed size affected W1000, LS, WS, and CPS. Landrace Campen, VS-2000, and VS-22 had the best physical qualities with W1000S and LS of 427.9, 338.6 and 221.4 g; 1.7, 1.4 and 1.3 cm, respectively. With respect to the physiological quality, Landrace Campen had the highest values for VE and DWAP (4.1 and 11.3 g, respectively). Yields of SY for the varieties oscillated between 10.6 and 15 t ha-1 MS and for grain between 4.3 and 10.6 t ha-1. Landrace Campen (7.1%) and VS-22 (6.3%) contained more CPS while VS-2000, H-157, H-358 and Campen had higher concentrations of starch (76.1, 74.8, 74.2, 73.8%, respectively). It was concluded maize seed quality is more affected by the variety than by the seed size. Varieties Campen, HS-2, Promesa and VS-22 showed the best physical and physiological quality. Variety was the most important factor afffecting SY with Campen, VS-22 and VS-2000 having the higher SY. Promesa, H-157 and HS-2 had the higher GY.

Key Words: Maize Stover, Varieties, Seed Size

M118 Evaluation of experimental and commercial maize hybrids for silage in the Highland Valleys Region. M. R. Tovar-Gomez*[1], J. L. Arellano-Vazquez[1], C. Perez-Mendoza[1], A. Peña-Ramos[2], and G. Nuñez-Hernandez[3], [1]*INIFAP-CEVAMEX*, *Texcoco, State Mexico, Mexico*, [2]*INIFAP-CAEPAB*, *Pabellon, Aguascalientes, Mexico*, [3]*INIFAP-CAELALA*, *Toreon, Coahuila, Mexico*.

A study was conducted to determine the productivity and nutritional value of maize cultivars for silage. Twenty experimental and commercial maize (Zea mays L.) hybrids adapted to different areas were evaluated in the Highland Valleys Region. The experiment was done during irrigation cycle PV-2004 in the Texcoco of the State of Mexico. The experiment used a randomized complete block design with three replications. The measured variables were: days to silk (DS), plant height (PH), lodging (LG), common corn rust (Puccinia sorghi Schw.,CCR), green matter yield (GMY) and dry matter yield (DMY), crude protein (CP) and in vitro DM digestibility (IVDMD). Significant varietal differences were observed for variables. Days to silk varied fro, 84 to 109 days and PH ranged from 190 to 283 cm. Cultivars with subtropical and tropical germplasm had higher occurrences of CCR. Fresh forage yeild (GMY) varied from 37.1 to 80 t/ha and DMY ranged from 12.8 to 24.8 t/ha. Across varieties, CP varied from 7.9 to 9.6% and IVDMD ranged from 68.2 to 76.2%. Multivariate analysis indicated that PH, CCR, GMY, IVDMD were most important in this study. The hybrids with subtropical × tropical germplasm were more susceptoble to rust and had lower yield potential. The hybrids with Highland Valleys × Tropical germplasm excelled in this study. Of this group, hybrids H-157E, H-161E, H-159E and H-165E were better.

Key Words: Maize Forage, Yield, Nutritive Value

M119 Green-chop maize forage production in temperate Mexico. H. Crespo-Lira[1], R. D. Améndola-Massiotti*[1], and J. A. Burgueño-Ferreira[2], [1]*Universidad Autónoma Chapingo*, *Chapingo, México, México*, [2]*CIMMYT*, *El Batán, México*.

Green chop maize is used during summer and autumn in dairy farms of temperate Mexico; however, there is little information on maize forage production under this utilization strategy which could imply the use of high levels of N (nitrogen) fertilization and sowing densities. The aim of this experiment was to evaluate forage yield of green chop maize under two levels of N fertilization, during summer and autumn. The study was carried out at Chapingo, Mexico (central area of the country), using an intermediate to late local hybrid (San Jose). The levels of fertilization were 150 (N1) and 200 (N2) kg of N/ha. The sowing density was 178571 seeds/ha. Experimental plots of 66 m^2 were used, in a randomized block design with two treatments (N1 and N2) and six replicates. At 50 (D1), 86 (D2), 122 (D3) and 158 (D4) days after sowing, per plot six systematically chosen samples of one m maize row each were harvested at 20 cm height above ground level. Analysis was performed using a mixed model, considering fixed effects of fertilization, sampling date and their interaction, and random effects of blocks and their interaction with treatment. Means were compared using Tukey's test. Plant density was not affected ($p>0.05$) by fertilization but was higher ($p<0.05$) in D1 (142188 plants/ha) than in the other dates (on average 125521 plants/ha), meaning that with such high plant densities about 12% of the plants were lost in early stages due to intra-specific competition. Forage yield was not affected ($p>0.05$) by fertilization, and increased ($p<0.05$) until D3 (3126, 16110, 23854 and 23480 kg of DM/ha for D1, D2, D3 and D4, respectively), meaning that with the lower level of N fertilization, an average forage accumulation of about 200 kg of DM/ha/d could be achieved in about 120 days. This result shows that green chop maize could be an alternative for dairy farmers at the end of the summer and beginning of autumn, since that level of production can not be achieved with other forage species in temperate Mexico.

Key Words: Plant Density, Nitrogen Fertilization, Days After Sowing

M120 Identification of ATP binding cassette transporter G2 (ABCG2) gene in mammary gland of Xinong Saanen Goat and its expression profile during lactation. H. J. Wu[1], J. Luo[1], N. Wu*[2], K. Matand[2], L. J. Zhang[1], B. J. Yang[1], X. F. Han[1], H. B. Wang[1], N. Zhang[1], G. Yu[1], and C. Y. Shan[1], [1]*Northwest A&F University*, *Yangling, Shanxi, P. R. China*, [2]*Langston University*, *Langston, OK*.

The ABCG2 gene codes for a protein that belongs to a trans-membrane proteins superfamily that mediates the ATP-dependent translocation of a variety of lipophilic substrates. The effect of ABCG2 gene on milk yield and composition has been reported in dairy cattle. However, there is limited information on ABCG2 gene structure, expression or functional analysis in dairy goats. This is the first report on ABCG2 gene coding region nucleotide sequence and expression pattern during the lactation period of the Chinese Xinong Saanen goats. The full sequence of this goat's gene coding region was sequenced and deposited into the GenBank nucleotide database (Accession number - DQ904356). This gene's complementary DNA contained an open reading frame of 1977 nucleotides that encoded a putative protein of 658 amino acids. The similarities between the nucleotide and peptide sequences of goat ABCG2 gene and putative protein compared with the bovine, human, and mouse homologs were 96%, 89%, 85% and 96%, 85%, 79%, respectively. Further, bioinformatical analysis showed that most of the goat ABCG2's virtually translated polypeptide sequence were predictably similar to those of bovine's and human's. However, the significant differences that were observed in coil-helix structures and optional motifs were species specific. When Real-time reverse transcription-polymerase chain reaction analysis was employed to explore the gene expression profile during lactation, the result showed a five-fold increase in expression level during peak yield, compared with the onset of lactation. Overall the results suggested that ABCG2 gene might be involved in goat milk synthesis probably by mediating lipophilic substrates translocation during early, peak, and mid-lactation stages.

Key Words: ABCG2, DNA, Polypeptide

M121 Differentially expressed gene profile during dairy goat whole lactation period. H. J. Wu[1], J. Luo*[1], N. Wu[2], K. Matand[2], L. J. Zhang[1], B. J. Yang[1], X. F. Han[1], H. B. Wang[1], N. Zhang[1], G. Yu[1], and C. Y. Shan[1], [1]*Northwest A&F University*, *Yangling, Shanxi, P. R. China*, [2]*Langston University*, *Langston, OK*.

The profile of mammary gland differentially expressed genes during the whole lactation of Chinese Xinong Saanen goat was determined by using suppression subtractive hybridization (SSH) approach. Mammary gland-subtracted cDNA libraries of different lactation stages were also constructed to facilitate target genes isolation. Real-time reverse transcription-polymerase chain reaction was applied to validate SSH results. Five target genes coding for serum amyloid A3 (SAA3), ATP-binding cassette subfamily G2 (ABCG2), heart fatty acid-binding protein (hFABP), xanthine dehydrogenase (XDH) and zinc-finger Ubi-d4 proteins (ZNP) were identified and analyzed. The expression level of ABCG2 and hFABP genes showed a significant increase from early to peak lactation stages. The results showed that their expression trends were similarly highest during peak yield and gradually decreased through mid, late and end of lactation. The results also reflected active functional involvement of proteins that were profiled in this study. ABCG2 and hFABP gene proteins seem to be involved in the mediation of ATP-dependent translocation of a variety of lipophilic substrates and lipid metabolism, respectively, during the peak of lactation; whereas XDH, a major constituent of the milk fat globule membrane, showed the expression trend similar to that of ABCG2 and hFABP, but with a mild increase during early and peak lactation stages. The expression pattern of SAA3, a lipid metabolism and cell proliferation protein, increased during early and late lactation, with a subsequent decline to baseline at the end of the lactation. Unlike other genes, ZNP gene expression increase began at the end of the middle lactation stage, with the highest point at the end of lactation. This results suggest a potential role of this gene′s protein in cell apoptosis.

Key Words: ABCG2 Gene, hFABP Gene, Polymerase Chain Reaction

M122 Initial gene expression analysis of Chinese Xinong Saanen goat mammary gland. X. F. Han[1], J. Luo[1], N. Wu[2], K. Matand*[2], B. J. Yang[1], H. J. Wu[1], L. J. Zhang[1], and H. B. Wang[1], [1]*Northwest A&F University*, *Yangling, Shanxi, P. R. China*, [2]*Langston University*, *Langston, OK*.

Goat is a major source of income and animal nutrients, primarily in developing countries. It is also an important animal research bio-system, but genomic studies are scarce in this species. This has resulted in a lower pace for genomic resources generation that could be used for goat production improvement. This pioneering study on goat mammary gland genomics was designed to construct and assess the functional quality of the mammary gland cDNA library and clones on Chinese Xinong Saanen goat. The results showed that the cDNA library was of high quality and contained 1.4×10^7 cfu with an average insert size of 1000 bp and recombinant rate of 96%. Sequencing analysis revealed that about 55.7% of sequenced clones were redundant, whereas 25% of them or 56.9% of the clone clusters represented novel genes. Functional analysis also showed that, although milk proteins which included beta-lactoglobulin, beta-casein, αs2-casein, kappa-casein and prealpha-lactalbumin were the most abundant. Other proteins involved in ribosomal structure, metabolism, immune response, and translation were also identified through sheep, cow and human cross-species genomic comparisons.

Key Words: cDNA, Genome, Goat

M123 Lactation curve characteristics of the Sarda goat breed. R. Steri[1], N. Bacciu[1], P. Fresi[2], A. Cappio-Borlino[1], and N. P. P. Macciotta*[1], [1]*Dipartimento di Scienze Zootecniche, Universitá di Sassari*, *Sassari, Italia*, [2]*Associazione Nazionale della Pastorizia*, *Roma, Italia*.

The Sarda is the largest Italian goat breed . Its main feature is represented by a high fitness to difficult environmental conditions that make this breed able to produce in areas that cannot be exploited with other species. A consistent strategy of genetic improvement should be preceded by a deepening of the knowledge on main productive characteristics of the animal and of main factors that affect these traits. In this study, 10,150 test day records for milk yield of 1,832 Sarda

breed goats were fitted with the incomplete gamma function of wood (WD) in the log-linear form and (logY = log a + b log t + ct) The WD model was fitted both to individual lactation curves and average lactation curves of goats with different parity (1st to 5th), kidding season (winter and spring) type of kidding (single or twins) and altitude of the flock (mountain, hill or plain).Estimated individual curves were ranked according to five levels of adjusted R-squared (ADJRSQ) and were classified as standard or atypical (presence or absence of the peak) on the basis of the signs for parameter b. Goodness of fit showed a wide range of variation, although about 38% of individual curves had and ADJRSQ>0.80. About 42% of individual curves show an atypical shape. The days in milk at which the peak occurs tends to increase with parity (from about 33 for first kidding goats to 23 for goats at the fifth kidding), with the number of kids born (15 vs 27 for one and two kids, respectively),with the season of kidding (25 vs 39 for winter ad spring) and with the altitude of location of flocks (14, 23 and 28 in flocks located on plain, hill and mountain, respectively). Milk yield at peak tend to increase with parity (from 1,32 liters for first kidding goats to 1.56 lt for goats at the fifth kidding), number of kids born (1.46 vs 1.55 for one and two kids , respectively), with the season of kidding (1.46 vs 1.60 for winter ad spring) and with the altitude of location of flocks (1.63, 1.43, 1.07 in flocks for plain, hill and mountain, respectively).

Key Words: Dairy Goats, Lactation Curve, Wood Model

M124 Milk production in goats supplemented with different levels of ruminally protected methionine. G. A. Flores, R. E. Gutierrez, D. D. Ruiz, F. X. Plata*, A. A. Ramirez, S. Vega, and G. D. Mendoza, *Universidad Autónoma Metropolitana Xochimilco*, *Mexico, D.F., Mexico*.

Twelve lactating multiparous Saanen goats (55.9 ± 5.6 kg) were fed a basal diet (14.4% CP, 26.71% RUP, 2.44 Mcal ME) with alfalfa, wheat bran, soybean meal, sorghum grain, corn grain, molasses, corn silage and oat straw (forage:concentrate ratio, 67:33). Goats were randomly assigned to the treatments, which consisted of three levels of ruminally protected methionine (RPM): 0, 2.5 or 5.0 g/d (Mepron M85 Degussa Co). Experiment was conducted for 30 days with measurements of milk production, composition and changes in body weight. Milk production was reduced ($P \leq 0.05$) with higher doses of RPM (1441^{ab}, 1698^{a}, 1390^{b} g/d for 0, 2.5 and 5.0 g/d respectively). Milk protein was reduced with 2.5 g of RPM (3.18^{a}, 2.86^{b}, 3.01^{ab}). No treatment effects were observed in milk fat or body weight. Higher doses of ruminally protected methionine affects negatively milk production in dairy goats presumably because the ratio lysine:methionie was reduced. More research is needed to determine optimum doses of ruminally protected methionine in lactating goats.

Key Words: Goat, Methionine, Milk

M125 *In vivo* prediction of body composition in goat dams 2) Relationship between IGF-I, body weight and body composition. C. A. Mejia*[1,2], G. Dominguez[2], E. Villagomez[1,3], M. Montaño[1,2], R. Basurto[1,2], H. Jimenez[1,2], and H. Vera[1,2], [1]*Cenid-Fisiologia INIFAP*, *Queretaro, Mexico*, [2]*FESC-UNAM*, *Queretaro, Mexico*, [3]*Cenid-Microbiologia INIFAP*, *D.F., Mexico*.

The objective of this research was to establish if plasma concentrations of IGF-I are related to weight and body composition of goat dams. A total of 64 goats from 2 genetics (Saanen and Creole) and 3 to 4 years of age, were used. Dams were divided in three groups according to their body score (BS, 1-5): LOW (1.5 - 2), MID (2.5 - 3) or HIGH (>3). Each of these groups received an integral diet for 12 weeks varying the offered amount to keep or establish these differences. At the end of this period (day 0), live weight (LW) and BS were registered. LW and BS were recorded 42 days later. This same day, a blood simple was obtained in the morning and another one in the afternoon. Plasma concentrations of IGF-I were determined by RIA, using a commercial kit. Dams were slaughtered at day 43 and inner fat was registered, and carcasses were weighed and stored in a cold chamber at 4°C. After 24 h, the left half of each carcass was dissected in fat (FAT), muscle (MUS), and bone tissue (BT). Data were analyzed by ANOVA and correlation using SAS software. There were no differences in plasma concentrations of IGF-I related to day time ($P>0.30$). Saanen dams had higher ($P<0.001$) IGF-I concentrations than Creole dams (262 vs 113 ± 15 ng/ml, respectively). The average of the two daily measures was used to make the correlation analyses. Despite the group (n=64), IGF-I correlations to LW (r=0.68), FAT (r=0.64), MUS (r=0.69; $P<0.001$) and BT (r=0.24; $P<0.07$) were meaningful. When data were analyzed by group, the correlation values of IGF-I to LW, FAT,and MUS continued being meaningful (r=0.57 a 0.77; $P<0.03$) for HIGH (n=21), MID (n=21) and LOW (n=22). However, correlation of IGF-I to BT was not meaningful in any of the three groups (r=0.05 a 0.20; $P>0.15$). We conclude that plasma concentrations of IGF-I are positively associated to body weight and body composition of goat dams.

Key Words: Body Composition, Goat, IGF-I

M126 Evaluation of the FAMACHA© system in lactating goats. M. Rovai*[1], T. A. Gipson[1], and L. J. Dawson[1,2], [1]*E (Kika) de la Garza American Institute for Goat Research, Langston University*, *Langston, OK, USA*, [2]*Oklahoma State University. College of Veterinary Medicine*, *Stillwater*.

The FAMACHA system has been adopted as a useful tool in meat goats for identifying clinical anemia associated with parasitism. However, the applicability of this method in dairy goats remains uncertain. The relation between FAMACHA system (FAM; scale based on the ocular conjunctiva color; 1–2 healthy, 3 border line, and 4–5 pale), fecal egg counts (FEC) and blood packed cell volume (PCV) were studied in 24 Alpine dairy goats measured every 2 wk throughout 7 month of lactation. All does were drenched with an anthelmintic at kidding. Samples for FEC were determined using modified McMaster method and classified as: low (≤750) and high (>750) eggs per gram feces. For PCV, measured by the microhaematocrit method, values of ≤19, 20–25, and > 25 were considered anemic, border line, and healthy, respectively. A false positive result was defined as animals with FAM 4–5 but not anemic and a false negative as animals with FAM 1–2 but anemic. The FEC values, log transformed, were affected by FAM ($P < 0.05$) where scores 4 and 5 showed low FEC (2.42, 2.49, and 2.23 for scores 1–2, 3, and 4–5, respectively). Moreover, high FEC had a tendency ($P= 0.07$) for low PCV values (2.52, 2.37, and 2.24 for anemic, border line, and healthy, respectively). For low FEC, 37% of animals were classified as FAM 4–5, 48% as border line, and only 15% FAM 1–2. The relation between FEC and PCV also presented a negative tendency ($P = 0.07$) which reaffirms the presence of high FEC with low PCV and, consequently, anemia. About 8.5% of goats would have been correctly treated with eye scores of 4–5 and low PCV values. However, 21% of the goats were false positive and would have

been treated unnecessarily. Although there is a physiological relation between FEC and PCV, the FAM system was not sufficient in itself for identifying anemia in dairy goats. Other causes (e.g., lactation stress) can be responsible for anemia, therefore FAM scores of 4–5 should be validated with FEC analysis.

Key Words: Dairy Goat, FAMACHA, Fecal Egg Count

M127 Protein and/or energy supplementation does not change forage digestibility in growing meat goat kids. J. M. Patterson*[1,2], B. D. Lambert[1,2], and J. P. Muir[1], [1]*Texas Agricultural Experiment Station*, *Stephenville*, [2]*Tarleton State University*, *Stephenville, TX*.

The nutritive value of supplements may affect feed intake and weight gains in growing goats. Our objectives were to determine the effects of protein and energy supplementation on growth, forage intake, forage apparent digestibility, and nitrogen retention in meat goat kids. In Experiment 1, an 18% crude protein complete goat grower was added to the diet of wethers eating coastal bermudagrass (CB) (12.2% CP, 67.5% NDF, 37.5% ADF), Tifton 85 bermudagrass (T85) (6.8% CP, 78.2% NDF, 45.1% ADF), or sorghum-Sudan (SS) (8.3% CP, 73.7% NDF, 47.9% ADF) hays. This experiment used seventy-two wether goats and measured the effects of the supplement on average daily gain (ADG) of goats fed one of three grass hays with or without supplemental levels (1% body weight daily) or *ad libitum* access to a complete goat grower. In Experiment 2, four wether goats were used in a 4×4 Latin square design and fed a SS basal diet (8.3% CP, 73.7% NDF, 47.9% ADF). Goats were confined to metabolic crates to facilitate total urine and fecal collection. Treatments consisted of no supplement, supplemental urea (200mg•(kg BW)$^{-1(d-1)}$), supplemental dextrose (0.2% BW^{-d}), or urea + dextrose ((200mg•(kg BW)$^{-1(d-1)}$), 0.2% BW^{-d}, respectively). In Experiment 1, ADG were -3.80, -4.97, and -6.56 for CB, T85, SS, respectively. ADG for hay plus supplement were 69.22, 61.62, and 58.12 for CB, T85, SS, respectively. Supplementation in Experiment 1 increased (P< 0.01) ADG for all hays by a factor of 5 over hay-only diets. Additionally, goats with *ad libitum* access to the complete feed had increased ADG compared to all treatments. In Experiment 2, protein and energy supplementation increased (P< 0.01) nitrogen retention. However, no differences (P>0.05) were shown for digestibility of dry matter, organic matter, acid detergent fiber, or neutral detergent fiber. We conclude that the beneficial effects of supplements in Experiment 1 and the increase in nitrogen retention in Experiment 2 cannot be explained by improvements in ruminal fiber utilization and could be due to post-ruminal energy and/or protein supply to the animal.

Key Words: Coastal Bermudagrass, Sorghum-Sudan, Tifton 85 Bermudagrass

M128 *In situ* dry matter degradation of cacti and fruits commonly selected by goats in the semi-arid region of North México. M. Guerrero-Cervantes[1], R. G. Ramírez-Lozano[2], R. Montoya-Escalante[1], A. S. Juárez-Reyes[1], and M. A. Cerrillo-Soto*[1], [1]*Universidad juárez del Estado de Durango*, *Durango, Durango, Mexico*, [2]*Universidad Autónoma de Nuevo León*, *Monterrey, Nuevo León, Mexico*.

The aim of this study was to determine the parameters of *in situ* DM degradability of cacti and fruits commonly selected by range goats in the semiarid region of North Mexico. Immature pods of *O. leucotricha*, *O. imbricata* and *O. leptocaulis*, and fruits of *O. leucotricha* and *O. imbricata* were collected, burned and milled. To determine the parameters of degradability, 5 g DM of samples were incubated in nylon bags for 0, 3, 7, 12, 24, 48, 72 and 96 h, in the rumen of 3 sheep fed alfalfa hay:concentrate (75:25). Results of DM degradability were fitted to exponential equation $P = a + b\ (1 - e^{-ct})$; where **a** is the intercept, **b** is slowly degradable fraction, **c** is the rate constant of disappearance of **b** fraction, and **a+b** is the potentially degradable fraction. Data were analyzed by analysis of variance for a completely randomized design. The DM degradability was different among species (P<0.05). The values for the fraction **a** were 20.9% higher in the fruit of *O. leucotricha* (white prickly pear) than the fruit of *O. imbricata*. The slowly degraded fraction **b** ranked the species *O. imbricata* higher and the fruit of *O. leucotricha* lower. *O. leucotricha* ranked intermediate (P<0.05). No differences (P>0.05) were recorded in the constant rate **c**. However, a numerical increment was observed in white prickly pear. The potential gas production **a+b** was 16.7% higher (P>0.05) in *O. imbricata* and *O. leucotricha* than the lowest counterpart (Fruit of *O. imbricata*). A similar trend was observed with effective degradability. Results indicated that white prickly pear, which is the fruit of *O. leucotricha* and *O. imbricata* represent valuable scarcity feeds in hot semiarid environments.

Table 1. *In situ* degradation of cacti and fruits commonly consumed by goats in the semiarid region of Mexico

	Parameters				
Species	a (%)	b (%)	c (% $^{-h}$)	a+b (%)	ED (%)
O. leucotricha	54.2^{b}	36.2^{b}	0.042	90.4^{a}	70.7^{a}
O. leptocaulis	55.5^{b}	31.4^{c}	0.059	87.0^{ab}	72.6^{a}
O. imbricata	48.5^{c}	47.2^{a}	0.030	94.0^{a}	65.5^{ab}
Fruit of *O. leucotricha*	58.1^{a}	22.8^{d}	0.088	78.3^{bc}	72.2^{a}
Fruit of *O. imbricata*	45.9^{c}	30.8^{c}	0.053	76.8^{c}	61.9^{b}
Mean	52.4	33.7	0.055	85.3	68.6
sem	0.99	1.68	0.02	3.37	2.75

[a,b,c,d] Means within columns with different superscript differ (P<0.05)

Key Words: Degradability, Goats, *In situ*

M129 *In vitro* gas production parameters of fruits commonly selected by grazing goats. M. Guerrero-Cervantes[1], R. G. Ramirez-Lozano[2], R. Montoya-Escalante[1], A. S. Juárez-Reyes[1], and M. A. Cerrillo-Soto*[1], [1]*Universidad Juárez del Estado de Durango*, *Durango, Dgo., Mexico*, [2]*Universidad Autónoma de Nuevo León*, *Monterrey, N.L., Mexico*.

The objective of the study was to determine the *in vitro* gas production parameters of fruits commonly selected by range goats in the semiarid region of North Mexico. Fruits from *P. leavigata*, *Opuntia leucotricha* (white prickly pear), *O. leucotricha* (red prickly pear), *O. imbricata* and *O. leptocaulis* were collected. Triplicate samples (500 mg DM) were incubated in 100 ml glass syringes. The gas production was registered at 3, 6, 9, 12, 24, 48, 72, and 96 h. Data were fitted to the equation: $p = a + b\ (1 - e^{-ct})$, were ***p*** represents gas volume at time ***t***, ***a*** is the gas produced (ml) from the soluble fermentable feed fraction, ***b*** is the gas produced (ml) from the insoluble but fermentable feed fraction, ***a + b*** is the potential gas production (ml), ***c*** is the the constant rate of gas production (% h^{-1}). Data were analyzed by ANOVA for a completely randomized design. Gas produced from the soluble ***a***

fraction was highest for red and white prickly pear ($P < 0.05$) whereas the fruits of *O. imbricata* and *P. leavigata* were lowest. The gas produced from the slowly degradable fraction ***b*** followed the same pattern than the ***a*** fraction. White prickly pear from *O. leucotricha* resulted in higher values; *P. leavigata* recorded the lowest ($P < 0.05$). The constant rate of gas production ***c*** was highest for white and red prickly pears, whereas fruits from *P. leavigata*, *O. leptocaulis* and *O. imbricata* were lower ($P < 0.05$). The highest potential gas production ***a+b*** was recorded in white prickly pear, and the lowest in *O. imbricata*. Data supported the fact that fruits from *O. leucotricha* represent a valuable source of food in harsh conditions in semi arid regions.

Table 1. *In vitro* gas production parameters of fruits

	Parameters			
	a	***b***	***c***	***a+b***
Fruits	ml/500 mg DM	ml/500 mg DM	% h^{-1}	ml/500 mg DM
P. leavigata	23.3^{c}	81.1^{c}	0.049^{b}	104.4^{d}
O. leptocaulis	36.1^{b}	83.7^{c}	0.040^{b}	119.9^{c}
O. imbricata	23.2^{c}	81.9^{c}	0.053^{b}	105.2^{d}
O. leucotricha **(red prickly pear)**	43.3^{a}	96.1^{b}	0.083^{a}	139.5^{b}
O. leucotricha **(white prickly pear)**	46.7^{a}	108.9^{a}	0.086^{a}	155.7^{a}
Mean	34.5	90.3	0.062	124.9
SEM	2.10	3.31	0.005	3.34

Means within columns with different superscript differ ($P<0.05$).

Key Words: Fruits, Goats, *In vitro* Gas Production

M130 Effects of dietary concentrate level on tissue and organ mass of Alpine does at different stages of lactation. A. T. Ngwa[1], L. J. Dawson[2], R. Puchala[1], G. Detweiler[1], R. C. Merkel[1], T. Sahlu[1], C. L. Ferrell[3], and A. L. Goetsch*[1], [1]*American Institute for Goat Research, Langston University*, *Langston, OK*, [2]*College of Veterinary Medicine, Oklahoma State University*, *Stillwater*, [3]*US Meat Animal Research Center*, *Clay Center, NE*.

Multiparous Alpine does (42) were used to determine how dietary concentrate level and stage of lactation affect mass of organs and tissues. Initial measures were conducted with six does a few days after kidding (0 wk). Eighteen does were fed a 60% concentrate diet (C) and 18 received one based on forage (20% concentrate; F) for 8, 16, or 24 wk of lactation. Intake of DM was greater ($P < 0.05$) for F vs C (2.23, 2.14, 2.10, 2.42, 2.81, and 2.55 kg/d), ADG was affected ($P < 0.07$) by an interaction between diet and time (0, 24, 121, -61, 46, and 73 g), and 4% fat-corrected milk was less ($P < 0.05$) in wk 17-24 than earlier (3.60, 2.78, and 2.45 kg/d for C and 3.02, 3.00, and 2.14 kg/d for F in wk 1-8, 9-16, and 17-24, respectively). Measures at 0 wk in % empty BW (EBW) included 51.1% carcass, 2.01% liver, 14.88% internal fat, and 6.57% gastrointestinal tract (GIT). Carcass mass was greater ($P < 0.05$) for F vs C and similar among times (50.8, 52.1, and 51.2% EBW for C and 52.6, 53.0, and 52.2% EBW for F at 8, 16, and 24 wk, respectively). Liver mass was similar between diets ($P = 0.13$) and greatest among times ($P < 0.05$) at 8 wk (2.87, 2.46, and 2.23% EBW for C and 2.81, 2.63, and 2.58% EBW for F at 8, 16, and 24 wk, respectively). Internal fat mass was greatest among times ($P < 0.05$) at 24 wk and greater for C vs F (11.40, 14.27, and 18.59% EBW for C and 9.39, 11.43, and 13.70% EBW for F at 8, 16, and 24 wk, respectively). Mass of the GIT was less ($P < 0.05$) for C than for F and decreased ($P < 0.05$) with increasing time in lactation (9.26, 7.56, and 6.21% EBW for C and 9.24, 8.50, and 7.87% EBW for F at 8, 16, and 24 wk, respectively). In conclusion, though milk production was not affected by diet partially because of greater DMI for F vs C, based on tissue mass more energy was expended by the GIT of F vs C does. In this regard, it appears that considerable internal fat is mobilized in early lactation particularly with forage-based diets, with more rapid and a greater magnitude of repletion by does consuming diets with high vs moderate or low concentrate levels.

Key Words: Body Composition, Dairy Goats, Lactation

M131 Effects of dietary starch sources on intake, growth and blood variables in growing goats. S. P. Wang, W. J. Wang, B. Lin, Z. L. Tan*, S. X. Tang, Z. H. Sun, and J. Y. Zeng, *Institute of Subtropical Agriculture, The Chinese Academy of Science*, *Changsha, P.R.China*.

The effects of dietary starch sources on feed intake, growth and blood variables were investigated in growing goats. Sixteen Liuyang black wether goats (Local breed; 15.0 ± 2.5 kg) were randomly allocated to four dietary treatments (4/treatment) for 54 d feeding period. The rations consisted of maize stover and concentrate containing soybean meal, fish meal, fat meal, rice husk, and a vitamin and mineral premix. Extra dietary starch was supplied, respectively with wheat grain, maize grain, sorghum grain, or paddy grain, all grounded and mixed with the concentrate to form four treatment diets with the same CP, starch and DE level. Goats were fed maize stover ad libitum, and the concentrate was provided daily in two equal portions at 0800 and 1700 h. The feed offered and orts were weighed daily, while animals were weighed at the beginning and end of feeding trail. About 20 ml blood samples were collected from the jugular vein at day 53 from each goat. Dry matter intake (DMI) of maize stover and concentrate, and daily weight gain of goats did not differ ($P > 0.05$) among treatments. Dietary starch sources affected ($P < 0.05$) the leucocyte numbers, the numbers and percentage composition of lymphocyte, intermediate cell and neutrophilic granulocyte, and the distribution dispersion of thrombocyte volume in whole blood. However, treatment did not affect ($P > 0.05$) the erythrocyte numbers, haemoglobin mass, haematocrit, average volume of erythrocyte, the distribution dispersion of erythrocyte volume, the thrombocyte numbers, the average volume of thrombocyte and packed thrombocyte in whole blood. Although these data suggest that dietary starch sources from cereal grains have no effect on DMI and growth, it affected the blood cell numbers.

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Key Words: Blood Variables, Performance, Starch

M132 Effects of dietary starch sources on meat quality and serum hormonal concentrations in growing goats. S. P. Wang, W. J. Wang, B. Lin, Z. L. Tan*, S. X. Tang, Z. H. Sun, and J. Y. Zeng, *Institute of Subtropical Agriculture, The Chinese Academy of Science*, *Changsha, P.R. China*.

The objective of this study was to examine the effects of different dietary starch sources on serum hormone concentrations and meat quality of growing goats. Sixteen wether goats (15.0±2.5 kg) were randomly allocated to four dietary treatments (4/treatment). Ration

consisted of maize stover and concentrate. The concentrate contained soybean meal, fish meal, fat meal, rice husk, and a vitamin and mineral premix. Extra dietary starch was supplied respectively by wheat grain, maize grain, sorghum grain and paddy grain which were grounded and mixed with the concentrate to form four treatment diets with the same CP, starch and DE level. Goats were fed maize stover ad libitum while concentrate was provided daily in two equal portions at 0800 and 1700 h. The feeding period lasted for 54 days. Blood samples were taken from the jugular vein on d 55 before the morning feeding to determine hormone concentrations. Thereafter the goats were slaughtered and about 350 g of longissimus dorsi from each goat were sampled for meat quality measurement. Dietary starch sources did not affect (P>0.05) the concentrations of insulin, growth hormone, T4, leptin, gastrin, and motilin in the serum. No significant differences (P>0.05) were observed in pH at 24 h after slaughter, drip loss for days 1, 3, 5, 7, 9, 14 and 21, cooked meat ratio, percentage of water loss between treatments. The pH at 45 min after slaughter, the content of total pigment and myoglobin were higher (P<0.05) in goats fed the paddy grain diet than the other diets. Crude protein content in the meat was higher (P<0.05) in goats fed the wheat diet than in goats fed the sorghum or the paddy diet. The current study demonstrated that different dietary starch sources could affect the pigment sediment and protein content of muscle tissues.

Acknowledgements: The work was partially funded by CAS (Kscx2-Yw-N-022).

Key Words: Hormone, Meat Quality, Starch

M133 Evaluating associative effects of different proportions of mixed forage species using gas production technique. S. X. Tang, Z. L Tan*, Z. H. Cong, Y, Hu, Z. H. Sun, and M. Wang, *Institute of Subtropical Agriculture, The Chinese Academy of Sciences*, *Changsha, P.R. China*.

The objective of this study was to investigate the associative effects of different forage species mixed with the mixture of *Rumex* and *Trifolium* (50:50, RT) at the proportions of 0:100, 25:75, 50:50, 75:25 and 100:0 respectively. The forage species included *Pennisetum Purpureum×P. americanum* (PPPA), *Guimu No.1* (GM), *Secale carele L* (SCL), *Pennisetum Purpureum Schum. Cvmott* (PPS), *Hemarthria japonica* (HJ), *Lolium perenne* (LP), and *Sorghum sudanens* (SS). Three goats (20±2 kg) were used. The goats were fed a diet consisting of 500 g kg^{-1} concentrate and 500 g kg^{-1} forage containing DE (3.15Mcal/kg DM) and CP (140 g/kg DM) and used as ruminal fluid donors for the preparation of inoculums. The gas production (GP) of the above forage combinations were measured in each vial after 12, 24 and 48 h of incubation. The associative effects were evaluated using their measured GP at 12, 24 and 48 h incubation time and their predicted GP. The predicted GP of combinative proportions was calculated according to GP of single RT and forage. The results were analyzed using completely randomized design in each incubation time with Duncan's multiple range test used for the comparison of means. The major combinations of RT and forages expressed significant positive associative effects (P<0.05) in gas production at different proportions. The negative associative effect (P>0.05) was only observed for the mixture of 25% RT and 75% GM at 12 h incubation time. The results indicated that the in vitro fermentation of forages could be improved through changing their combinative proportions.

Acknowledgements: The work was partially funded by CAS (KSCX2-YW-N-49).

Table 1.

Incubation time, h	proportion, %	Associative effect, % RT:PPPA	RT:GM	RT:SCL	RT:PPS	RT:HJ	RT:LP	RT:SS
12	25:75	5.3	-3.4	4.4	14.6*	8.6*	8.8*	5.7*
	50:50	6.6*	2.6	6.18	16.6*	8.3	8.5*	10.4*
	75:25	7.3*	7.0*	17.4*	13.8*	16.6*	9.0*	11.3*
24	25:75	7.9*	2.7	3.67	9.6*	6.0*	5.2*	6.2*
	50:50	8.0*	6.3	5.8	15.0*	4.1	4.5*	9.3*
	75:25	9.4*	9.1*	15.1*	13.9*	14.3*	6.5*	9.6*
48	25:75	9.0*	5.0	2.2	13.5*	5.8*	8.8*	1.7
	50:50	9.0*	6.7	5.0	18.1*	0.7	4.7*	7.8*
	75:25	8.9*	8.8*	15.1*	14.0*	13.3*	5.6*	8.7*

*, p<0.05. Associative effect=100×(Measured GP-Predicted GP)/ Predicted GP.

Key Words: Associative Effect, Gas Production, Forage

M134 Ingestive behavior of goats fed with urea in the diet. L. S. Amorim*[1,4], C. A. A. Torres[1], E. A. M. Amorim[1,4], J. F. Fonseca[2], J. H. Bruschi[3], and M. T. Rodrigues[1], [1]*Federal University of Vicosa*, *MG, Brazil*, [2]*Embrapa Small Ruminant Research Center*, *Sobral, CE, Brazil*, [3]*Embrapa Dairy Cattle Research Center*, *Juiz de Fora, MG, Brazil*, [4]*Colorado State University*, *Fort Collins, CO*.

True protein supplements are the most expensive ingredients in diets. Therefore, substitution of a true protein supplement with a non-protein N source may significantly reduce the diet costs. However, studies have demonstrated that urea addition in the diets is related to increases in the ammonia concentrations in the serum and plasma blood, therefore has diminished the reproductive performance. A trial was conduced with 20 Toggenburg goats, not pregnant and nonlactating, averaging 48.55 ± 7.87 kg BW, 2.97 ± 0.5 ECC and 34.33 ± 20.80 months old distributed in five randomized blocks to evaluate the effect of the addition of high urea levels on the diet on feeding behavior. The goats were fed with two diets (TRT) contend 0 and 2.2% of urea in the total DM basis of the ration. Diets consisted of 60% of Tifton hay (Cynodon ssp.) and 40% of concentrate, formulated to be isonitrogenous (14% CP, DM basis). Treatments consisted of 0 (TRT1) and 2.2% of urea in the total DM basis of the ration (TRT2), that it was substituted by the meal corn in the concentrated mixture. The animals were allotted to individual pens. The data measured was time spent eating (TSA), time spent ruminating (TRU), time spent idle (TID), time spent on foot (TFO), time spent lying down (TLY), chewing time (TCH) and ruminating chewing by number bolus (RCB), was determined by means of the visual observation of the animals, at intervals of ten minutes, for a period 24 hour. During the nocturnal collection of the data, the environment was kept with artificial illumination. Data were analyzed by ANOVA using the glm procedure of SAS (version 8.7). No statistical difference was observed between treatments (TRT1 and TRT2, respectively) on TSA 283.4 vs. 290.86 min, TRU 392.16 vs. 399.62 min, TID 748.86 vs. 756.32 min, TLY 835.67 vs. 843.13 min, TFO 586.77 vs. 594.23 min, TCH 41.38 vs. 48.84 min and RCB 54.49 vs. 61.95. The urea in the diet did not change the feeding behavior of animals.

Key Words: Behavior, Goats, Urea

M135 Lysophosphatidic acid (LPA) stimulates activiation of ERK-1/2 and proliferation of C_2C_{12} cells but does not result in a significant increase in total DNA. J. M. Scheffler*, A. K. Batie, and S. J. Jones, *University of Nebraska*, *Lincoln*.

Lysophosphatidic acid (LPA) plays an important role in modulating cell survival, proliferation and apoptosis in a variety of cell lines. LPA's possible role in proliferation makes it a candidate to be a component used in defined cell culture media. Skeletal muscle expresses all four LPA receptors, however, the role LPA plays in skeletal muscle has not been clearly defined. This study investigated the effect of LPA on proliferating C_2C_{12} cells by a variety of means. Serum starved C_2C_{12} cells were treated with serum free Dulbecco's Modified Eagle Medium (DMEM) with either 5% fetal bovine serum or 50, 25, or 12.5 μm LPA. Total DNA, proliferation (thymidine incorporation), cell cycle analysis (flow cytometry), and ERK were measured. The FBS treatment stimulated ($P<.05$) an increase in DNA, LPA did not stimulate ($P<.05$) an increase in total DNA. During a 48 h period, there was an increase in [3H]thymidine incorporation after 24 h. Treatment with LPA did result ($P<.05$) in the phosphorylation of ERK-1/2 within 5 min, however, phosphorylation was not maintained to the extent seen with serum addition. Cell cycle analysis by flow cytometry revealed that LPA stimulated a transient increase in proliferation which abated by 24 h. These results indicate that LPA stimulates proliferation of C_2C_{12} cells and activation of ERK-1/2, however, these responses are transient. A significant increase in DNA could be detected after 48 h.

Key Words: LPA, ERK1/2, DNA

M136 Phospho-MAPK as a marker of myogenic satellite cell responsiveness to growth factors. D. C. McFarland* and J. E. Pesall, *South Dakota State University*, *Brookings*.

Previous studies identified variation in the mitogenic response of subpopulations of turkey myogenic satellite cells to growth factor stimuli. Further work determined that this was not due to differences in growth factor receptor numbers or affinity between the subpopulations. In order to determine if the differential response to growth factor stimuli was due to variation in the levels of activated intracellular signaling proteins, a Western blotting procedure was utilized to measure the levels of phospho-MAPK (phospho-ERK 1/2). Confluent cultures of turkey satellite cells were rinsed and administered serum/growth factor-free medium for 3 hrs. Following this, treatment media were applied to the cells for 3 min. Cells were then scraped from the wells, extracted, and the supernatant subjected to Western blotting with anti-phospho-ERK 1/2 antibodies and visualized by chemiluminescence. Initial measurements using serum mitogenic stimuli showed differences in phospho-MAPK levels between the clonal subpopulations, but the responses did not correlate with proliferation rates of the individual clones ($P > 0.05$). IGF-I alone did not increase phospho-MAPK levels compared to non-growth factor controls ($P > 0.05$), whereas fibroblast growth factor (FGF) did result in increased levels ($P < 0.05$). A synergistic response was seen in cells administered both IGF-I and FGF. When administered FGF and IGF-I, 2 of the slow growing clones exhibited lowest levels of phospho-MAPK ($P < 0.05$). One of the slow growing clones had similar levels of phospho-MAPK to the three fast growing clones ($P < 0.05$). Similar results were seen with cells administered FGF, IGF-I, platelet-derived growth factor BB and hepatocyte growth factor. The results suggest that variation in the responsiveness of some satellite cell subpopulations may be due to differences in phospho-MAPK generation.

Key Words: Muscle, Satellite Cells, Turkey

M137 Mapping the glucocorticoid responsive element of the growth hormone gene in chicken embryonic somatotrophs. K. A. Heuck* and T. E. Porter, *University of Maryland*, *College Park*.

Normal expression of growth hormone (GH) in the chicken pituitary occurs around embryonic day (e) 14 and can be induced earlier by the glucocorticoid (GC), corticosterone (CORT). Induction of GH gene expression by CORT can be blocked by the protein synthesis inhibitor, cycloheximide, indicating an indirect effect requiring translation of an intermediary protein(s). Furthermore, no consensus glucocorticoid response element (GRE) exists within 10 kilobase (kb) upstream and 5 kb downstream of the GH gene, only several imperfect GRE half sites. Therefore, the objective of this study was to identify the GC-responsive region of the GH gene. A previous report indicated that reporter constructs containing 1.7 kb of the chicken GH gene 5′-flanking region were minimally responsive to GC (two-fold) in rat pituitary cell line. In the present study, luciferase reporter constructs were tested containing 1.4 and 1.7 kb of the GH promoter. Chicken e11 pituitary cells were used to avoid effects of heterologous cell lines. Constructs were evaluated in 5 separate experiments, and luciferase activity compared by analysis of variance. Reporter activity of the 1.7 kb construct showed a mean twelve-fold increase over basal when treated with CORT. Deletion of the 1.7 kb region to 1.4 (-1467) kb resulted in ablation of reporter activity ($P<0.05$; $n=5$). Preliminary experiments with constructs with 1.6 (-1620) kb and 1.5 (-1544) kb of the GH promoter recapitulated the 1.7 kb response in reporter activity ($n=1$), indicating that a GRE resides in a region between 1.5 kb and 1.4 kb upstream of the chicken GH gene. Inspection of this region reveals potential binding sites for Ikaros, ELF2, HNF1 and CREB, which are known to be regulated by GC or involved in cell differentiation. We conclude that the chicken GH gene is responsive to GC without a classical GRE and that this response is most likely indirect due to other GC-responsive transcription factors binding upstream of the GH gene.

Key Words: Growth, Pituitary, Gene Expression

M138 Intestinal morphology and gene expression differences between broiler chicken lines selected for divergent growth rates. E. R. Feierstein*[1], E. R. Gilbert[2], M. E. Persia[1], E. A. Wong[2], W. W. Saylor[1], and C. J. Schmidt[1], [1]*University of Delaware*, *Newark*, [2]*Virginia Polytechnic Institute and State University*, *Blacksburg*.

Modern broilers have been selected for rapid growth, and a reasonable hypothesis is that this selection may have affected intestine development or function. The objective of this study was to compare intestinal gene expression patterns between two strains of broilers that exhibit different growth properties. For this study, a broiler strain Ross-708 (Allen Poultry Company) was compared with strain IL50, an inbred strain maintained at the University of Illinois that exhibits growth

properties similar to those seen in broilers in the early 1950's. At 35 d post hatch, the mass of the IL50 birds was 60% of the size of the Ross birds. Also, the intestine of the IL50 birds contributes 3.1 (± 0.1)% of the bird mass, while the intestine of the Ross line contributes 2.4 (± 0.1)%. The growth of the duodenum, jejunum and ileum was monitored during that period by sacrificing birds at weekly intervals and measuring the mass and length of the individual intestinal segments. The increase in length was complex, with both strains exhibiting a plateau in all three segments between d 7 and 14. During this period the segments continued to increase in mass. RNA was prepared from d 2 and 14 post-hatch duodenal segments and quantitative real time PCR used to determine the expression levels of various nutrient transporters. For example, ANOVA analysis indicates the mRNA encoding peptide transporter 1 (PepT1) mRNA decreased ($P < .05$) between d 2 to d 14. In addition, we have used microarrays to evaluate global patterns of gene expression in this segment. This study may be useful for identifying candidate genes that have played a role in improving production traits during the past 50 years.

Key Words: Poultry, Intestine, Gene

M139 Cloning of chicken ras-dva: Glucocorticoid regulation in the embryonic anterior pituitary. L. E. Ellestad*[1,2], S. A. Jenkins[1], and T. E. Porter[1,2], [1]*Department of Animal and Avian Sciences, University of Maryland*, *College Park*, [2]*Molecular and Cell Biology Program, University of Maryland*, *College Park*.

Understanding mechanisms involved in initiating pituitary growth hormone (GH) expression during embryogenesis should aid in developing strategies for improving growth in broiler chickens. Circulating corticosterone (CORT) increases GH production between embryonic day (e) 12 and e14 in the chicken through a mechanism involving a Ras protein. This study was aimed at characterizing chicken Ras-dva, a candidate gene that may mediate CORT induction of GH during development. Through random sequencing of a cDNA library, we identified and sequenced in its entirety a putative Ras-dva clone. Comparison of chicken Ras-dva with GenBank and with vertebrate genomes indicated that homologs are present only in non-mammalian vertebrates. Phylogenetic comparison of our nucleotide sequence (1276 bp) with that in fish and frogs indicated an overall identity of 52-62%, and the predicted amino acid sequence of chicken Ras-dva (208 aa) is 74-76% identical to Ras-dva in other non-mammalian vertebrates. Pituitary expression of Ras-dva in the chicken was confirmed with RT-PCR, and ontogenic analysis indicated that pituitary Ras-dva mRNA increases between e10 and e17 in a manner similar to GH ($P<0.05$; n=4). CORT treatment increased Ras-dva mRNA in e11 anterior pituitary cells in vitro ($P<0.05$; n=4). Although the increase was less than that in cells receiving CORT alone, Ras-dva mRNA was induced by CORT in the presence of a protein synthesis inhibitor ($P<0.05$; n=4), indicating that it may be a direct target of the glucocorticoid receptor (GR). Analysis of potential regulatory regions of the chicken Ras-dva gene identified three putative GR binding sites within 5 kb upstream and one within 4.2 kb downstream of its transcription start site. Six potential binding sites for the pituitary-specific factor Pit-1 were also identified within 5 kb upstream, indicating that Ras-dva may be expressed in Pit-1 expressing cells such as GH-producing somatotrophs. We conclude that Ras-dva is a glucocorticoid-induced gene in the chicken anterior pituitary gland that may play a role in initiating GH expression during embryonic development.

Key Words: Growth Hormone, Somatotroph, Corticosterone

M140 Identification of potential feed efficiency biomarkers. C. P. Ojano-Dirain*[1], N. R. Pumford[1], T. Wing[2], M. Cooper[2], J. Lay[3], R. Liyanage[3], and W. G. Bottje[1], [1]*Center of Excellence for Poultry Science, University of Arkansas*, *Fayetteville*, [2]*Cobb-Vantress, Inc.*, *Siloam Springs, AR*, [3]*State Wide Mass Spectrometry Laboratory, University of Arkansas*, *Fayetteville*.

Our previous research has reported that certain mitochondrial proteins were differentially expressed in breast muscle, liver and duodenum in broilers with high or low phenotypic expression of feed efficiency (FE, gain to feed). The objective of this study was to identify proteins that are expressed differently in readily accessible tissue, such as lymphocytes or plasma, from broilers with high or low FE. In Experiment 1, lymphocytes were isolated from whole blood of broilers with a continuum of FE (n = 25 to 48) using density gradient Histopaque-1077. Results of Western blot assay showed a significant correlation ($P<0.05$) between FE and the levels of vinculin and cytochrome c in lymphocytes. Using the level of these two potential biomarkers, we found that we could identify the bottom 30% of birds in terms of FE with ~90% accuracy. In Experiment 2, plasma was separated by 2D electrophoresis and four separate gels from each group of high or low FE broilers were analyzed for significant differences. Ten proteins from the plasma proteome were expressed differently ($P<0.05$) between the high and low FE broilers. Of these 10 proteins, 4 have been identified using MALDI-TOF MS, namely transthyretin, histone deacetylase 1 and 2, adipophilin and albumin. Although the mechanism behind the association of plasma proteins to FE is yet unknown, results of this study indicates that some mitochondrial and extramitochondrial proteins are potential candidates for developing a biomarker assay that could aid in identifying low FE birds for exclusion from the breeding line.

Key Words: Feed Efficiency, Broilers, Potential Biomarkers

M141 Physiological function of butoxybutyl alcohol a novel compound in broilers. S. Inada*, A. Ohtsuka, and K. Hayashi, *Kagoshima University*, *Kagoshima city , Korimoto, Japan*.

We have shown that sweet potato shochu distillery by-product (SDBP) contains growth promoting factor. Butoxybutyl alcohol (BBA) is a new compound which may be responsible for the growth promotion. The ether extract of SDBP was first fractionated by a Sephadex column (Sephadex LH-20), purified by HPLC (high performance liquid chromatography) and the chemical structure was determined by NMR (nuclear magnetic resonance) and MS (mass spectrometry). In the present study, chemical synthesis of BBA was carried out using butanol, butyric aldehyde and *p*-toluenesulfonic acid as the catalyst. After the fractionation by a Sephadex column, BBA was verified by HPLC. Then physiological function of BBA was investigated *in vivo* (broiler) and *in vitro* (chick muscle cells). Birds (Cobb strain, male) were raised under 24 ±1° C in wire bottom cages for 20 d from 15 d of age. Feed (CP 23%; 3200 kcal ME/kg) and water were given *ad libitum* during the experimental period. BBA was mixed into the feed at the level of 70 ppm. Body weight was recorded every 3 d and feed intake was recorded daily. At 35 d of age, all the birds were killed and dissected to measure muscle and organs weights. Blood was collected to measure GOT (glutamate oxaloacetate transaminase) as an index of liver function. In the case of *in vitro* experiment, BBA was added to the culture medium at the levels of 1, 10 and 100 ppm, and cells were cultivated for seven days. BBA increased feed intake ($P<.05$) and growth was facilitated. Feed conversion, abdominal fat weight, liver

weight, spleen weight and serum GOT were not changed by BBA. Muscle TBARS (thiobarbituric-acid reactive substances) as an index of lipid peroxidation was significantly decreased by BBA. Protein content of the cultured muscle cell was increased (P<.05) by 1 and 10 ppm BBA, but decreased by 100 ppm BBA.

Key Words: Broiler, Growth Promotor, Distillery By-product

M142 Bone mineralization in nine pedigree lines of meat-type chickens. P. Talaty*[1], M. N. Katanbaf[2], and P. Y. Hester[1], [1]*Purdue University*, *West Lafayette, IN*, [2]*Cobb-Vantress, Inc.*, *Monticello, KY*.

The variability of bone mineral density (BMD) and bone mineral content (BMC) of the tibia, ulna, and radius of 9 Cobb pure lines (L) of chickens were accessed at 6 wk of age. Bone mineralization of 9 birds/line/sex was determined using dual energy X-ray absorptiometry. Using the mixed model of SAS, data for BMC, bone length, and bone area were analyzed using an analysis of covariance with BW as the covariant. An ANOVA was used for BMD and bone width as BW was nonsignificant as a covariant. Bone within bird (used a subplot), line of chicken, and sex of the bird were considered fixed effects. The BMD did not differ among pedigree lines. Interactions with sex and bone were nonsignificant indicating that the BMD response was the same for all 9 pedigree lines with respect to the sex of the bird and the type of bone scanned. However, all other traits measured in this study including BW, BMC, bone length, bone width, and bone area were different among lines ($P < 0.001$). The two pedigree lines (L 7 and L8) with the lightest 6-wk-old BW (2033 and 2055 g, respectively) had diverse skeletal traits. Birds of L7 had the lowest BMC (1.05 g), shortest bone length (69.2 mm) and smallest bone area (8.0 sq cm); however, the other pedigree line low in BW (L8) showed the opposite trend in that bones from these birds were the highest in BMC (1.38 g), bone length (74.6 mm), and area (9.2 sq cm) when compared to all of the other lines. It was the BMC of the tibia and not the radius and ulna that caused the differences in BMC among pedigree lines of chickens (line × bone interaction, $P < 0.0001$). The BMD of L8 was also the highest of all pedigree lines that were compared, but the difference was non-significant ($P = 0.12$). The overall CVs calculated for skeletal traits across all genetic lines were high with BMD at 51% and BMC at 80%. It is concluded that large differences in skeletal traits exist among pedigree lines of meat-type chickens.

Key Words: Bone Mineralization, Bone Mineral Density, Pedigree Chickens

M143 The expression of neutral amino acid transporter B^0 and mTOR proteins along the gut mucosal crypt-villus axis in the formula-fed neonatal pig. C. Yang[1], X. Yang[1], D. Lackeyram[1], Y. L. Yin[2], K. Swanson[1], F. Verrey[3], and M. Z. Fan*[1], [1]*University of Guelph*, *Guelph, ON, Canada*, [2]*Institute of Subtropical Agriculture, the Chinese Academy of Sciences*, *Changsha, Hunan, China*, [3]*Institute of Physiology, University of Zurich*, *CH-8057 Zurich, Switzerland*.

The intestinal apical Na+-neutral amino acid (AA) transporter B^0 is believed to be the primary transporter for the uptake of luminal neutral AA across the apical membrane. Our previous work demonstrated a high level of apical B^0 transporter activity along the jejunal crypt-villus axis in fed neonatal pigs. However, the B^0 gene (mRNA) expression is low in proliferating crypt cells and increases with cell differentiation in the villus cells. This study was conducted to examine how B^0 protein is expressed along the jejunal crypt-villus axis in fed neonatal pigs. Six Yorkshire gilts were removed from sows at d 5 of age and fed a milk protein-based liquid formula till 14-16 d of age before being sacrificed for tissue collection. Three major intestinal epithelial cell fractions from the jejunum, representing cells from the upper villus, the middle villus and the crypt regions, were sequentially isolated, with cell viability of 92-95%, as assessed by trypan blue exclusion, by the distended sac method. Western blot analyses were used to examine the protein abundance of Na+-neutral amino acid (AA) transporter B^0 and the mammalian target of rapamycin (mTOR) protein phosphorylated (Pi). No differences ($P>0.05$) were observed in B^0 protein abundance among the cell homogenate, soluble, and the apical membrane along the three cell fractions. A higher ($P<0.05$) mTOR protein-Pi was observed in the middle villus cells. The crypt cell also expressed relatively high level of the activated mTOR protein. The results suggest that the B^0 protein expression along the gut crypt-villus axis may be regulated at posttranscriptional level and the mTOR-signaling pathway may be involved in the regulation in the fed neonate.

Key Words: Na+-Neutral Amino Acid Transporter B^0, Neonates, The Mammalian Target of Rapamycin (mTOR)

M144 Modulation of protein synthesis by somatotropin and insulin in skeletal muscle of growing pigs. F. A. Wilson*, H. V. Nguyen, A. Suryawan, R. A. Orellana, J. G. Fleming, A. S. Jeyapalan, and T. A. Davis, *Childrens Nutrition Research Center, Baylor College of Medicine*, *Houston, TX*.

Chronic treatment of pigs with porcine somatotropin (pST) for 7 days increases feed efficiency by both promoting whole body protein synthesis in the fed state and reducing whole body protein degradation during fasting. pST-treated pigs have higher plasma insulin levels than vehicle-treated controls. This study aims to determine whether the increase in protein synthesis of pST-treated pigs is mediated through an insulin-induced stimulation of translation initiation. Growing pair-fed, weight-matched pigs were treated with pST (150 μg/kg/day, n=18) or vehicle (n=18) for 7 to 10 days. Pancreatic glucose-amino acid clamps were performed in overnight fasted pigs to attain plasma insulin levels of 5, 25 and 50 μU/ml, equivalent to reported insulin levels in 1) fasted control and fasted ST-treated, 2) fed control, and 3) fed-pST treated pigs, respectively. Amino acid and glucose levels were maintained at fasting levels. Skeletal muscle protein synthesis was measured with the flooding dose method and western blotting was used to identify changes in the abundance and activation of translation initiation factors in muscle. Statistical analysis was performed using ANOVA. Plasma levels of urea nitrogen were lowered ($P<0.001$) and insulin-like growth factor-1 levels increased ($P<0.005$) in pST-treated pigs indicating effectiveness of pST treatment. Insulin increased protein synthesis in muscle of control ($P=0.01$) and pST-treated ($P=0.07$) pigs. Treatment with pST also increased muscle protein synthesis ($P<0.05$). The abundance of the active translation initiation complex eIF4G-eIF4E and the phosphorylation of eIF4G in muscle mirrored the changes in muscle protein synthesis in response to insulin, however there was no clear effect of pST. We conclude that both insulin and pST stimulate protein synthesis in skeletal muscle of growing pigs.

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Key Words: Somatotrohin, Pig, Insulin

M145 Impact of different doses of ractopamine in swine carcass and meat characteristics from Large White and Duroc breeds. E. F. Leonardo[1], I. L. Stella[1], A. C. M. S. Pedreira[2], G. B. Mourão[1], and E. F. Delgado*[1], [1]*Escola Superior de Agricultura "Luiz de Queiroz"*, *Piracicaba, SP, Brazil*, [2]*Agência Paulista de Tecnologia do Agronegócio*, *Piracicaba, SP, Brazil*.

Lean meat production has been an important issue for health and economical reasons in swine meat industry. Sixty animals (30 castrated males and 30 females) being 30 Large White (LW) and 30 Duroc (DU) were randomly assigned to different doses of ractopamine (RAC): 0 (control), 10 ppm and 20 ppm in the diet. The experiment started when animals reached 85 kg of live weight and ended after 4 weeks when animals were 110 kg. The *L. dorsi* muscle samples were collected 24 h postmortem (PM) from the left carcass side in a commercial abattoir. The WB shear force (WBS) was measured 24 h PM (d 1) and 5 d after slaughter (d 5). Rib eye area (REA) and fat thickness (FT) were measured 24 h PM. WBS on d 1 were higher (P≤0.01) for LW (7.58±0.32 kgf) than DU breed (6.09±0.38 kgf). Differences in WBS remained on day 5 (P≤0.01) for LW and DU breeds (4.83±0.21 and 3.86±0.25 kgf, respectively). The WBS for d 1 were not different between RAC doses but higher than control diet (0: 6.12±0.44; 10 ppm: 6.86±0.43; 20 ppm: 7.51±0.44 kgf; P≤0.05). On d 5, WBS was different between RAC doses and also compared to the control diet (0: 3.74±0.29; 10 ppm: 4.23±0.28; 20 ppm: 5.07±0.29 kgf; P≤0.05). LW animals had greater REA (P≤0.05) than DU breed (37.7±1.0 and 34.3±1.2 cm^2, respectively). Rib-eye area for females and males were different (37.7±1.1 and 34.3±1.2 cm^2, respectively). There was a FT interaction between breeds and sex condition (P=0.083). FT were different between RAC doses (P≤0.05) and also compared to the control diet (P=0.054) (0: 2.62±0.13 cm; 10 ppm: 2.53±0.12 cm; 20 ppm: 2.10±0.13 cm). The results confirmed the leaner carcass production when RAC is added to diet. However, in those pure breeds doses of RAC did not modified REA. The negative effect of increased RAC dose on swine meat tenderness was also observed.

Key Words: Warner-Bratzler Shear Force, Meat Tenderness, Swine Meat

Immunology - Livestock and Poultry I

M146 Pro-inflammatory response of chicken thrombocytes to lipopolysaccharide. T. R. Scott* and M. D. Owens, *Clemson University*, *Clemson, SC*.

Thrombocytes (10^7) from blood of SCWL chickens were cultured 1 hr in the presence of lipopolysaccharide (LPS). LPS concentrations of 0, 0.1, 1 and 10 µg/ml were used. Following culture, thrombocytes and culture media were separated by high speed centrifugation. Cell pellets were resuspended in RNA*later*™. RNA was extracted from cells for real-time PCR of GAPDH, Toll-like receptor 4 (TLR4), IL-1β, IL-6 and IL-12. Culture media supernatant histamine (H) and prostaglandin E2 (PGE2) concentrations were determined with homologous time-resolved fluorescence assays. GAPDH was used as the housekeeping gene, and the expression of this was unaffected by any concentration of LPS used in culture with the thrombocytes. TLR4 was found to be constitutively expressed by thrombocytes and its expression was not altered by any concentration of LPS. Expression of IL-1β, IL-6 and IL-12 were all increased by LPS stimulation of thrombocytes in culture. H release by thrombocytes in culture was not affected by LPS. PGE2 concentrations in culture supernatants were found to be increased following LPS treatment. Although different from the 0 µg/ml control, the expressions of cytokines and PGE2 concentrations were not different among 0.1, 1 and 10 µg/ml LPS used in culture. Chicken thrombocytes express TLR4 and respond to LPS stimulation with increased pro-inflammatory cytokine expression and PGE2 release.

Key Words: Thrombocyte TLR4, Pro-inflammatory Cytokines, Prostaglandin E2

M147 Pro-inflammatory response of broiler chick thrombocytes. F. Ferdous*, D. V. Maurice, and T. R. Scott, *Clemson University*, *Clemson, SC*.

Broiler chicks at 4 weeks of age were bled to obtain thrombocytes for in vitro stimulation with lipopolysacchardie (LPS). The chicks had been fed a chick starter diet or the same diet supplemented with either corticosterone (CS) or vitamin C plus corticosterone (VitC). The diets were fed to the chicks from 2 to 4 weeks of age in order to induce body conditions indicative of stress. After 2 weeks of feeding, the chicks exhibited differences in feathering and body weight with the control chicks being largest and well-feathered while the VitC chicks were intermediate in both features and the CS chicks were small and poorly feathered. Isolated thrombocytes (10^7) were cultured for 1 hour with 0 or 10 µg/mL LPS. Following culture the cells were separated from the supernatants by high speed centrifugation. The thrombocyte pellets were resuspended in RNA*later*™, and RNA was extracted with the RNeasy Kit. RNA samples were processed for real-time PCR of GAPDH, IL-1β, IL-6 and IL-12. GAPDH was used as the housekeeping gene, and its expression was not affected by any dietary treatment nor concentration of LPS. The thrombocyte pro-inflammatory cytokines were unaffected by the diets, but 10 µg/mL LPS significantly induced greater expression of these above 0 µg/mL LPS. Although dietary induced stress can affect other physiological parameters in broiler chicks, the LPS induced expression of thrombocyte IL-1β, IL-6 and IL-12 are not altered.

Key Words: Thrombocytes, Pro-inflammatory Cytokines, Stress

M148 Identification of antimicrobial peptides in avian heterophils using whole cell MALDI-TOF. L. Kannan*[1,2], N. C. Rath[1], R. Liyanage[2], and J. O. Lay[2], [1]*USDA/Agricultural Research Service*, *Fayetteville, AR*, [2]*University of Arkansas*, *Fayetteville*.

Mass spectrometry (MS) is a rapidly emerging tool not only to characterize specific biomolecules but also to characterize and identify prokaryotic cells using whole cell MALDI-TOF-MS (matrix assisted laser desorption ionization time of flight). In order to study the potential of this technique to explore the eukaryotic cell associated peptides we isolated heterophils from the peripheral blood of chickens and turkeys and subjected to whole cell MALDI-TOF in the mass range of 1-20kDa. The mass-spectrum obtained showed a prominent peak at m/z 3915 in chicken and at m/z 4132 in turkey heterophils. Since heterophils occur abundantly in bone marrow, we isolated these peptides from the bone marrow extracts of both the species using

reverse phase liquid chromatography. Edman sequencing and peptide mass fingerprinting followed by fragmentation data obtained for a couple of tryptic peptides using post source decay experiment were used in MASCOT database search and it yielded 3915 to be gallinacin-2. Similarity database search found a corresponding significant hit for turkey heterophil peptide-2 (THP-2) which is in agreement with the MALDI-TOF observed nominal mass 4132 Da. These are antimicrobial peptides which serve as natural defense mechanism in many species of animals. Peptide search indicate that gallinacin-2 and THP-2 consist of 36 amino acids and contain 6 invariant cysteines that form three disulfide bonds thereby sharing more than 90% of sequence homology. However with the sequence obtained we noticed that THP-2 consist more number of arginine which shows that THP-2 is more cationic compared to gallinacin-2. These results demonstrate that, development of a rapid method to prospect for cell associated factors or bioactive peptides using 'whole cell MALDI' may be a viable method to study their physiology.

Key Words: Heterophils, Antimicrobial Peptides, Mass Spectrometry

M149 Adjuvants containing diverse peptidoglycan structures modulate hen antibody response to immunization. D. L. Trott*, E. M. Hellestad, and M. E. Cook, *University of Wisconsin*, *Madison*.

Hen egg yolks are utilized as a commercial source of polyclonal antibody, and adjuvant modifications have been shown to modulate hen antibody response to vaccination. Previous work showed that the addition of killed gram-positive *Staphylococcus aureus* or *Clostridium perfingens* to Freund complete adjuvant (FCA) consistently increased egg antibody titers to a test antigen, phospholipase A_2 (PLA_2), as compared to unmodified FCA. We tested the hypothesis that the increased titer due to adjuvant modification was due to the presence of lipoteichoic acid (LTA). Eight hens per treatment were injected with either FCA plus PLA_2 (FCA) or FCA/LTA from S. aureus (modified FCA) plus PLA_2. The vaccine composed of FCA was prepared by emulsifying 0.5 ml phosphate buffer saline containing 6 mg PLA_2 with in 0.5 ml adjuvant. The FCA/LTA vaccine was the same composition plus 2 mg purified LTA. In each hen, the 1 ml vaccine was injected i.m. into 4 injection sites. All hens received a second vaccination 7 days later with 3 mg/ml PLA_2 emulsified in Freund incomplete adjuvant administered in same manner as described above. Egg yolk antibody titer to PLA_2 was determined by ELISA. Results showed that *S. aureus* LTA modification of FCA decreased antibody titer 45% as compared to unmodified FCA. To determine the importance of peptidoglycan structure (PGS) as an adjuvant, a second study was conducted to determine if modification of FCA with killed bacteria containing diverse PGSs had added adjuvant effects. The killed bacteria added to the adjuvant were based on the diamino acid at position 3 of the PGS within the muramyl dipeptide (the smallest unit in FCA known to have an adjuvant effect). Using *Corynebacterium*, *S. aureus*, and *Streptococcus suis* combinations with FCA it appeared that the addition of stem peptides different than found in FCA increased the adjuvant effect (as much as 1.7 fold). These results would suggest that the adjuvant effects of FCA can be improved, and that attention to the PGS may offer insight into successful modifications.

Key Words: Egg Yolk Antibody, Adjuvants

M150 Immunocytochemical demonstration of neuroendocrine cells in chicken Peyer's Patches. C. H. Chen* and L. R. Berghman, *Texas A&M University*, *College Station*.

Peyer's patches (Pp), the secondary gut-associated lymphoid organ of the mucosal immune system, was named after the Swiss anatomist Hans Conrad Peyer in 17th-century. Because the chicken gastrointestinal tract lumen is exposed to the external environment, much of it is populated with potentially pathogenic microorganisms. Thus, chicken Peyer's patches (C-Pp), characterized by aggregations of lymphoid tissues, serve an important site for monitoring immunological and inflammatory responses against enteric pathogens. The novel staining method developed by L. E. Vaughn et al. (Avian Dis. 2006) was used for accurate identification the C-Pp from fresh intestine tissue specimens of White Leghorn chickens (SCWL) (ages ranging from 3 weeks to 2 years) and 7-week old broilers. Typical C-Pp were found in 7-week old broilers and 3-4 week old SCWL. Macroscopically, C-Pp were observable as elongated thickenings of the intestinal epithelium measuring from 3 milimeters to 1 centimeter in length. Light microscopic evaluation of H&E stained C-Pp tissue slides revealed oval lymphoid follicles located in the mucosa and extending into the submucosa of the ileum. M-cells that were located in a unique pocket-like structure on the basolateral side of the lumen were also observed. Chromogranin A (CgA)-positive cells were found exclusively in C-Pp, but not in the intestinal segments adjacent to the C-Pp. C-Pp play an important role in the immunological surveillance of the intestinal lumen and in facilitating the generation of the immune response within the mucosa. Interestingly, our observations provide morphological evidence for the potential involvement of neuroendocrine cells in the immune function of the C-Pp. Future studies will focus on determining the nature of the neuropeptides produced locally by the diffuse neuroendocrine system in the C-Pp.

Key Words: Peyer's Patches, Neuroendocrine Cells, Chromogranin A

M151 Altered monocyte/macrophage numbers in blood and organs of chickens injected i.v. with LPS. O. T. Bowen*, R. F. Wideman, and G. F. Erf, *University of Arkansas*, *Fayetteville*.

We recently reported peak circulating levels of nitric oxide (NO) 5h post–lipopolysaccharide (LPS) injection (i.v.) in chickens. To examine the ability of monocytes from in vivo LPS injected (1 mg) chickens to produce NO in vitro, young adult male chickens were injected i.v. with LPS and peripheral blood mononuclear cells (PMNC) were collected 5h later. PMNC were cultured with and without LPS and NO in the culture supernates assessed by nitrite assay at 1, 6, 12, 18, and 24h of incubation. Exposure to LPS in vivo attenuated further LPS stimulation in vitro (24 h NO level: 9.1 ± 3.8 μM vs. 39.1 ± 6.5 μM, in vivo LPS vs. control; $P<0.001$). When NO production was examined in PMNC cultures established at 5h and 48h post–in vivo LPS injection, in vitro LPS stimulated NO production again was attenuated in cultures established 5h after in vivo LPS ($P=0.03$), but not in cultures established 48h after in vivo LPS (NO level: 26.6 ± 3.5 μM vs. 22.1 ± 3.7 μM, in vivo LPS vs. control; $P=0.46$). Cell population analyses of the PMNC cultures established 5h post–in vivo LPS revealed reduced monocytes levels compared to controls (KUL01+: 3.6 ± 0.9% vs. 9.3 ± 1.1%, respectively; $P<0.001$). Hence, the lower in vitro LPS–stimulated NO production observed in these PMNC cultures is likely due to a reduction in monocytes in the blood. To gain insight into the potential redistribution of monocytes from the blood into tissues, the presence

of macrophages in the lung, spleen, and liver collected 0, 1, 3, 6, and 48h after LPS injection was examined. Compared to controls, the % area occupied by KUL01+ cells in tissue sections of lung, spleen, and liver decreased 1 h post–in vivo LPS injection (lung: 7.7 ± 1.0% vs. 5.0 ± 0.7%, P=0.004; spleen: 9.2 ± 0.4% vs. 2.2 ± 0.3%, P<0.001; and liver: 5.4 ± 0.7% vs. 2.4 ± 0.5%, P=0.002, respectively) and returned to normal or above normal by 48h in all tissues but the lung. Further studies are needed to determine whether the observed decrease in monocytes/macrophages is due to death of cells and/or redistribution to other tissues or specific locations in tissues.

Key Words: LPS, Chicken, Macrophage

M152 Oxidative stress and immune response in the chicken. S. Bush*[1,2], K. Gyenai[1], X. Guan[1], and T. Geng[1], [1]*Virginia Polytechnic Institute and State University*, *Blacksburg*, [2]*University of North Dakota*, *Fargo*.

Oxidative Stress (OS) occurs when an organism has higher levels of oxidants than antioxidants. In this research, OS and Immune Response (IR) are analyzed in chickens. We are evaluating OS and IR to determine if a higher oxidative state would induce a higher or lower immune response in the birds. Oxidative stress occurs when there is an imbalance between an organism's free radicals and their antioxidants. When in excess, free radicals damage cellular macromolecules including DNA, lipid and protein. Here, we hypothesized that lowered immune response is one consequence of the macromolecular damage. Therefore the objective of this summer internship investigation was to evaluate the correlation between immune response and oxidative stress. Biomarkers used as indicators for OS were Thio Barbiturate Acid Reactive Substances (TBARS) and Malondialdehyde (MDA). Chickens were classified as either high or low immune response based on antibody titers produced in response to a challenge with sheep red blood cells. Based on both TBARS and MDA, high immune response birds had a significantly higher level of oxidative stress than low antibody producing chickens. The results appear to support earlier reports in the mouse that immune response was associated with immune response. The work provides a foundation for further investigating the role of oxidative stress in the general well-being of chickens.

Key Words: Chickens, Oxidative Stress, Immune Response

M153 Effects of immunoglobulin binding on signal transduction in bovine polymorphonuclear neutrophils. M. J. Paape* and Y. Wang, *Bovine Functional Genomics Laboratory, USDA-ARS*, *Beltsville, MD*.

Immunoglobulins are major molecules that mediate humoral immune responses. Their functional effects on leukocytes are mediated by the cell surface receptors for the Fc domain of immunoglobulins (FcR). Ligation of FcR on human polymorphonuclear neutrophils (PMN) is capable of triggering a wide range of biological activities, including phagocytosis, secretion of granules, generation of respiratory burst, antibody-dependent cellular cytotoxicity (ADCC), and production of proinflammatory mediators and cytokines. Bovine immunoglobulins IgG_2 and IgM but not IgG_1 bind to bovine PMN. The immunoglobulin binding pattern of bovine PMN is consistent with the major opsonic roles of IgG_2 and IgM for phagocytosis by bovine PMN. In this study, changes in intracellular free calcium concentrations ($[Ca^{2+}]_i$) and protein tyrosine phosphorylation (PTP) induced by immunoglobulin binding to bovine PMN were investigated. Purified bovine IgG, IgG_1, IgG_2, IgM and heat aggregated IgG (aIgG) were used. IgG_1 alone or crosslinked with a second antibody did not induce changes in $[Ca^{2+}]_i$ and PTP. IgG_2 alone or crosslinked with a second antibody and aIgG induced a strong PTP response without changes in $[Ca^{2+}]_i$. Crosslinking of IgG caused a rapid $[Ca^{2+}]_i$ increase of 91 nM without a PTP response. IgM did not induce $[Ca^{2+}]_i$ influx or PTP responses. However, crosslinking IgM with anti-bovine-IgM resulted in an increase of 115 nM in $[Ca^{2+}]_i$ and a strong PTP response on 45, 55, 100 and 115 kD proteins. Anti-bovine-IgM antibody alone induced a similar $[Ca^{2+}]_i$ influx and PTP response, indicating a high occupancy of IgM on bovine PMN surfaces. The immunoglobulin binding pattern of bovine PMN is consistent with the major opsonic roles of IgG_2 and IgM for phagocytosis by bovine PMN. Binding of these opsonic antibodies may trigger pathways for effective PMN phagocytosis and oxidative burst activity.

Key Words: Neutrophil, Bovine, Immunoglobulin

M154 Evaluation of a bovine respiratory pathogen exposure model on immune response and short-term performance of finishing cattle. B. McLaughlin*[1], L. O. Burciaga-Robles[1], D. L. Step[2], C. R. Krehbiel[1], M. Montelongo[2], A. W. Confer[2], R. W. Fulton[2], C. J. Richards[1], U. DeSilva[1], and G. Zhang[1], [1]*Department of Animal Science, Oklahoma State University*, *Stillwater*, [2]*Center for Veterinary Health Sciences, Oklahoma State University*, *Stillwater*.

The objective was to determine effects of an intratracheal *Mannheimia haemolytica* (Mh) challenge following short-term exposure (72 h) to Bovine Viral Diarrhea (BVD) persistently infected calves on white blood cell (WBC) count and differentials, DMI and performance in feedlot steers (BW = 305±20 kg). Treatments included: 1) steers not challenged with BVD or Mh (CON); 2) steers intratracheally challenged with Mh only (MH); 3) steers challenged with BVD, no Mh (BVD); and 4) steers challenged with BVD and Mh (BVD+MH). Feed, total urine and feces were collected during the first 2 wk post challenge. In addition, blood samples were collected at -72, 0, 7, 18, 36, 72, 96, 168, 336, and 672 h post challenge. Rectal temperature was greater ($P < 0.001$) for BVD+MH and MH during the first 24 h after the Mh challenge. For BVD+MH and MH, total WBC count was greater ($P < 0.01$) at 36 h post *M. haemolytica* challenge compared with CON, whereas in BVD steers, WBC count was lower ($P < 0.01$). Total lymphocyte count was lower ($P = 0.004$) during the first 72 h post BVD exposure for both the BVD and BVD+MH groups compared with MH and CON, and this difference remained at 96 h post *M. haemolytica* challenge. An increased ($P < 0.001$) total neutrophil count was observed during the first 36 h for the MH group and for 72 h for the BVD+MH challenge group. Although data were not significant ($P > 0.10$), ADG was 1.29, 1.04, 0.88 and 0.75 kg/d and G:F was 0.180, 0.122, 0.110 and 0.092 kg/kg for CON, BVD, BVD+MH, and MH steers, respectively, during the first 17 d post challenge. We conclude that the challenge model was successful at inducing bovine respiratory disease (BRD) associated with BVD and *M. haemolytica*. Understanding the physiological changes in morbid animals will lead to improved strategies for decreasing severity and economic losses associated with BRD.

Key Words: Bovine Viral Diarrhea, *Mannheimia haemolytica*, Steers

M155 ***In vivo*** **characterization of the recall response to antigen in chickens vaccinated with attenuated** ***Salmonella*** **mutants expressing M2e protein.** S. E. Higgins*, S. L. Layton, A. D. Wolfenden, K. Cole, B. M. Hargis, and G. F. Erf, *University of Arkansas*, *Fayetteville*.

We recently developed attenuated Δ*aro*A *Salmonella enteritidis* strains (ΔSE) that express the Influenzavirus epitope M2e, with or without a 10 aa CD154 (CD40 ligand) sequence. These mutants were orally administered to broiler chicks (10^7cfu/chick day-of-hatch, boosted with 10^8cfu at 32d). Mutants evaluated were ΔSE, ΔSE expressing M2e, ΔSEM2e and CD154, or ΔSE expressing multiple copies of M2e with CD154. Serum antibodies against M2e were detectable by 11d post-vaccination and steadily increased to day 20. To evaluate cell-mediated immune activity, we injected antigen on day 44 into the pulp of small growing feathers of five chickens per vaccination group. Three different antigen injections (sterile saline, M2e peptide conjugated with BSA (M2e-BSA), and ΔSE constructs homologous to the initial vaccine strain)(10μL) were made into separate feathers on each chicken. Feathers were collected 24h post-injection, and hematoxylin and eosin stained sections were prepared. Each sample was evaluated for the extent of leukocyte infiltration into the feather pulp (score 0-3; none to high level, respectively). Mean leukocyte-infiltration (MLI) scores following saline injection were ≤1 in all vaccination groups. The MLI score in response homologous ΔSE constructs was higher ($P<0.05$; 2.00-2.50) than that of saline controls in all groups. However, MLI scores following M2e injection in birds vaccinated with ΔSE expressing M2e were not different from those of saline controls. M2e-BSA injection into feathers of ΔSE (without M2e) vaccinated chickens (not M2e-sensitized) resulted in a MLI score of 2.6, which was higher than MLI scores observed in response to saline or M2e-BSA injection in birds vaccinated with ΔSE expressing M2e ($P<0.05$). Considering the low recall response to M2e-BSA in M2E sensitized birds, together with the observed antibody response to M2e in serum, it appears that the M2e-containing ΔSE constructs favor initiation of a humoral response over a cell-mediated immune response.

Key Words: Salmonella, M2e, Leukocyte

M156 Immune responses of dairy calves vaccinated at 2 versus 6 weeks of age. J. J. R. Patlola* and J. M. Smith, *University of Vermont*, *Burlington*.

Dairy calf raisers are implementing vaccine protocols with little documented evidence of efficacy in young calves. In this project, immune responses of calves vaccinated at different ages (2 wk vs. 6 wk) were determined. Twenty Holstein heifer calves on a custom replacement raising operation were enrolled. Calves were assigned to 1 of 2 groups based on their age. Of 10 age-matched calves in Group 1, 7 were vaccinated at 6 wk of age and 3 (unvaccinated controls) were not. Of 10 age-matched calves in Group 2, 7 were vaccinated at 2 wk of age and 3 were not. Vaccinated calves received 2 ml of a modified-live virus vaccine against infectious bovine rhinotracheitis (IBR), bovine viral diarrhea 1 and 2, parainfluenza-3, and bovine respiratory syncytial virus (BRSV). Blood was collected immediately before and 3 wk after vaccination. Calves were sampled at 6 and 9 wk of age in Group 1, and at 2 and 5 wk of age in Group 2. Lymphocyte proliferation was measured by thymidine incorporation after stimulation with various antigens (Vista 5 vaccine, IBR and BRSV antigens). Total serum IgG and Vista 5-specific IgG were measured by ELISA. Proliferative responses in 6-wk-old calves were greater than in 2-wk-old calves. The intensity of proliferation with Vista 5 was more pronounced than with other antigens. Three wk after vaccination, Vista 5-specific IgG were higher in calves vaccinated at 6 wk of age. There was no effect of vaccination on body weights and total serum IgG. The results of this study demonstrated that vaccination produces greater cell mediated and humoral responses in 6-wk-old calves as compared to 2-wk-old calves. Elucidation of the type of cells responding to early vaccination and demonstration of efficacy against challenge are needed to fully evaluate the usefulness of vaccinating calves at 2 wk of age.

Key Words: Dairy Calf, Vaccination, Lymphocyte Proliferation

M157 Campylobacter infection in day-old chickens. K. J. Genovese*, H. He, D. J. Nisbet, and M. H. Kogut, *USDA-ARS, FFSRU*, *College Station, TX*.

Intra-abdominal *Campylobacter* infection facilitates the characterization of peripheral blood leukocyte dynamics and abdominal cell infiltrates. Day-of-hatch leghorn chickens were injected intra-abdominally with *Campylobacter jejuni* [(CJ) 10^8 colony-forming units (CFUs)]. Peripheral blood leukocyte numbers were monitored at 0, 2, 4, 8, and 24 hours post-injection. In mortality studies, birds were injected intra-abdominally with 1 x10^8 CFUs CJ and mortalities were recorded for 72 hours post-injection. In CJ-injected chicks, total white blood cell (WBC) numbers began increasing by 2 hours post-injection, peaking at 4 hours post-injection, with the predominant cell type being polymorphonuclear leukocytes (heterophils). Total WBCs declined after 8 hours and this decline continued, with total WBC numbers approaching control values at 24 hr. Injection of CJ into the abdominal cavity caused a rapid rise in abdominal cell infiltrates, with the predominant infiltrating leukocytes being heterophils. Peak abdominal heterophil infiltrates were observed at 8 hours post-injection, declining only slightly by 24 hours post-injection. Chick mortality in the CJ challenge groups reached 30%. Mortality in the *Salmonella enteritidis* positive control groups was greater than 50%. The data suggest that *Campylobacter* infection does stimulate the innate immune response in chickens, however the response and infection is not characterized with the high levels of pathogenesis observed with a Salmonella infection. The present studies provide a foundation for the study and characterization of the avian immune response to *Campylobacter* and for the study of intervention strategies to prevent infection and colonization of poultry.

Key Words: Campylobacter, Heterophil, Innate Immunity

M158 Genetic and phenotypic factors influencing milk, protein and fat yields of dairy cows in Tasmania, Australia. S. A. Adediran[1], P. Nish[2], D. J. Donaghy[1], J. R. Roche[1], and A. E. O. Malau-Aduli*[1], [1]*University of Tasmania*, *Hobart, Tasmania, Australia*, [2]*Tasherd Pty Ltd*, *Hadspen, Tasmania, Australia*.

The Australian State of Tasmania enjoys a cool, temperate climate that remains the backbone of its pasture-based dairy production system. In this study, 330,366 lactation records from 428 Tasmanian dairy herds collected between 2000 and 2005 were analysed. The objective was to determine the influence of genetic and non-genetic factors on milk, protein and fat yields of pasture-based dairy cows. The data were statistically subjected to analyses of variance using general linear mixed model procedures with repeated measures. State-wide average milk yield per lactation over a standard 305-day lactation length was 5200.7 ± 1239.7 litres (ranging from 1107 to 13256 litres), while fat and protein yields averaged 205.5 ± 47.0 kg (ranging from 53 to 385 kg) and 166.2 ± 41.5 kg (ranging from 47 to 297 kg), respectively. Highly significant ($P<0.001$) effects on milk, protein and fat yields attributable to variation in herd size, cow's parity, breed, season and year of calving were detected. Milk yield increased linearly with increase in parity (means of 3482.4, 4019.5, 4615.4, 4826.1 and 5018.8 litres per lactation for parities 1, 2, 3, 4 and >4, respectively). Milk, fat and protein yields were highest in cows calving during the spring season (4769.8 litres, 215.2kg and 168 kg respectively), Holstein-Friesian genotypes produced the most milk (5211 litres), protein (171 kg) and fat (210kg) yields per lactation. Herd sizes of more than 1110 cows produced the most milk, fat and protein. Productivity per cow increased with calving year except in 2003 when total milk yield was lower than in 2002. We conclude that herd size, breed, parity, season and year of calving were among the main factors driving production of dairy cows in Tasmania and adjustments for these factors would be mandatory for any unbiased comparison of lactation performance within and between pasture-based dairy production systems.

Key Words: Milk Protein, Fat, Tasmania

M159 Impact of Warana Dairy Cooperative on the socio-economic status of farmers in Maharashtra, India. R. A. Patil*[1] and T. R. Dhiman[2], [1]*Warana Milk Cooperative*, *Warananagar, Maharashtra, India*, [2]*Utah State University*, *Logan*.

Warananagar is a cooperative complex established in 1958 with the objective of socio-economic development of rural Warana, Maharashtra, India. A milk cooperative was established under this complex during 1969-70 with 200 employee and procurement of 4000 liters of milk per day from 36 nearby villages. The objective of this study was to quantify the changes in structure of a rural cooperative from 1970 to the present and its influence on the Socio-economic development of rural people in Maharashtra, India. During 2006 milk cooperative collected daily 280,000 liters of milk, has 57,000 members, 1750 employee, a milk processing and a dairy product manufacturing facility. The data related to socioeconomic status of members between 1970 and 2006 was statistically analyzed. The annual turnover of the cooperative has grown significantly from $3 million in 1970 to $50 million in 2006. Interestingly, the women membership in the cooperative has changed significantly from 16% in 1970 to 46% of total members in 2006. Out of total 1250 societies in the cooperative, 161 are managed by women members. Milk cooperative in 1970 was selling milk locally and today exporting cheese, butter, ice cream and other dairy products to large cities in India and to Gulf, Africa and Asian countries. The cooperative currently has 126 full time artificial insemination technicians that perform 90,000 inseminations per year. Societies are connected with cooperative complex through an internet for procurement, payment and other record keeping. Cooperative supplies fodders seed and cattle feed to the members at non-profit basis and provides extension education. As a result of improved animal management and feeding, the milk yield of cows has increased significantly from 2.2 liters/d in 1970 to 4.0 liters/d in 2006. The present per capita income of cooperative members is $360. Our study concluded that a high technology dairy cooperative is managed successfully by producers with a significant role of women and having a positive impact on the animal productivity and per capita income of members.

Key Words: Dairy, Milk, Extension

M160 Metabolizable energy content and *in vitro* gas production characteristics of subtropical grasses of Northeastern Mexico. H. Bernal-Barragán[1], E. Gutiérrez-Ornelas[1], E. M. Romero-Treviño[2], J. Colin-Negrete[1], M. A. Cerrillo-Soto*[3], and A. S. Juárez-Reyes[3], [1]*Universidad Autónoma de Nuevo León*, *Monterrey, Nuevo León, México*, [2]*Instituto Tecnológico*, *Altamira, Tamaulipas, México*, [3]*Universidad Juárez del Estado de Durango*, *Durango, Durango, México*.

The objective of this study was to determine the *in vitro* gas parameters and to estimate the metabolizable energy (ME) content of subtropical grasses used for beef cattle production in Northeastern Mexico. Samples of Guinea (*Panicum maximum*), Pangola (*Digitaria decumbens*), Bermuda (*Cynodon dactylon*), Tanzania (*Panicum maximum* var Tanzania), Pretoria 90 (*Dichantium annulatum*) and Buffel (*Cenchrus ciliaris*) were collected at bloom stage and analyzed. Triplicate samples (500 mg DM) were incubated in calibrated 100 ml glass syringes. Ruminal fluid, used as inoculum was obtained from two sheep fed alfalfa hay:concentrate (75:25). Gas production was recorded at 0, 3, 6, 9, 12, 24, 48, 72 and 96h. Data were fitted to the equation: $p=a+b(1-e^{-ct})$. The ME content (Mcal kg^{-1} DM) of samples was calculated by: ME = (2.20 + 0.136GP24h + 0.057CP + 0.0029CF2)/4.184. Statistical analysis was performed by ANOVA for a completely randomized design, and means were separated by the Tukey test. Content of ME was highest for Pangola, lowest for Buffel and intermediate for Guinea, Bermuda, Tanzania and Pretoria 90; extreme ME values were 3.2 for Pangola and 1.8 Mcal ME kg^{-1} DM for Buffel ($P<0.05$). Pangola showed the highest value for the **b** fraction ($P<0.05$) and Guinea and Bermuda the lowest. The highest constant rate **c** was for Guinea, whereas the values were 30% and 45% lower for Pretoria and Buffel ($P<0.05$). The **a+b** fraction was highest for Pangola and Pretoria 90, intermediate for Tanzania and Buffel, and lowest for Guinea and Bermuda. Ranking of subtropical grasses using *in vitro* gas parameters (**b** and **a+b**) was similar to results obtained for ME content. Combinations of the studied variables allowed to recognize the potential of Pangola grass for grazing cattle in Northeastern Mexico.

Table 1. ME content (Mcal/kg DM) and *in vitro* gas production parameters of subtropical grasses of Northeastern Mexico incubated in rumen fluid *in vitro* (ml/500 mg DM)

	ME	b	c	a+b
Guin	2.3[b]	109[d]	0.04[a]	102[d]
Ber	2.0[c]	102[d]	0.04[ab]	102[d]
Pan	3.2[a]	149[a]	0.03[bc]	143[a]
Pret	2.3[b]	142[ab]	0.03[cd]	138[ab]
Buf	1.8[d]	125[c]	0.02[d]	118[c]
Tan	1.9[cd]	137[b]	0.03[bc]	130[b]
SEM	0.04	6.05	0.005	5.85

[a,b] Means within columns differ (P<0.05). b = Gas from the slowly degraded fraction and a+b = The potential gas production, in ml; c = The rate constant (%/h).

Key Words: Grasses, Energy Content, *In vitro* Gas Production

M161 Evaluation of the center costs methodology sensibility by technologies introduction in the cow-calf production system. R. P. Oaigen, J. O. J. Barcellos*, T. E. Oliveira, E. R. Prates, and L. F. Christofari, *Federal University of Rio Grande do Sul*, *Porto Alegre- RS - Brasil*.

A bioeconomical simulation model was developed in a traditional production system in cow-calf (TPS) for the application of cost center methodology with the objective of evaluating its sensibility by the introduction of technologies of early weaning in primiparous cows (EWS), improved natural pasture for primiparous cows and half the lot of secundiparous cows (INP) and protein supplementation for replacement heifers in the first winter (PSS). All technologies were used to increasing the pregnancy rate in this system (TPS). Data on biological performance was obtained from a bibliographic review on production indicators and cost and economic values were obtained from market. The inputs of the model were: herd structure, production costs and production technology. The outputs of the model were: operational cost (OC); spented cost (SC); production costs per centers (PCC); unitary cost per calf (UCC); weaned kilo cost (WC/kg); annual cost per cow (ACC); financial break-even (FBE), operational margin (OM), pregnancy rate (PT), calf crop (CC), productivity/cow (P/C), number of weaned calves (NWC), calves break-even (CBE) and total production in kilos (TP/kg). The use of the methodology of cost centers was sensitive in identifying variations in the technical economic indicators and in the costs of each productive center. The introduction of EWS, INP and PSS showed in the increase of technical indicators and in the operational margin, presented a straight relation with the changing in the cost centers, proving the sensibility of the costs methodology in relation to the impact in TPS.

Key Words: Modeling, Cow-Calf, Production Cost

M162 Quality of vetch lines for hay and spring grazing. A. Larbi*[1], S. Rihawi[1], and S. Hassan[2], [1]*International Center for Agricultural Research in the Dry Areas*, *Aleppo, Syria*, [2]*General Commission for Scientific Agricultural Research*, *Damascus, Syria*.

Vetches (*Vicia* spp) are important feed legumes for production of hay, grain and straw, and early spring grazing; but data on nutritive value of high-yielding and disease tolerant vetches (elite lines) selected by the International Center for Agricultural Research in the Dry Areas (ICARDA) to replace low-yielding local cultivars in the non-tropical dry areas is scanty. Two experiments were conducted in Syria to compare the nutritive value of elite lines of common vetch (*V. sativa*, line 2566) and bitter vetch (*V. ervilia*, line 2520) with a released cultivar of common vetch 'Baraka' as control. In Experiment 1, the vetches were grazed by weaned Awassi lambs for 31 and 42 days in 2005 and 2006 respectively to compare their potential for spring grazing. Forage-on-offer (FOF) and average daily gain (ADG) were monitored. Experiment 2 compared hay from the vetches as a protein supplement to low-quality cereal straw basal diets. Four adult Awassi rams were fed barley straw supplemented with hay from the vetches for 28 days. Voluntary dry matter intake of vetch, organic matter digestibility (OMD) were determined from data from the last 7 days of the trial. The vetches differed (P<0.05) in FOF, ADG, voluntary intake and OMD. Average values were - FOF:3.34, 4.31, 3.42 t/ha; ADG: 147, 116, 159 g/head; voluntary intake of vetch: 44.4, 48.4, 37.7 gDM/W$^{0.75}$; and OMD: 696, 667, 747 g/kg for common vetch line 2556, bitter vetch line 2520 and the released common vetch cultivar 'Baraka' respectively. The study showed that common vetch line 2566 has similar forage potential as the released cultivar for spring grazing and hay production based on forage yield and ADG.

Key Words: Vicia Hay, Sheep Grazing, Nutritive Value

M163 Utilization of pruning waste of cactus pear orchards as a forage source for sheep in Temascalapa, Mexico. C. A. Flores-Valdez, G. Aranda-Osorio*, and M. Cruz-Miranda, *Universidad Autonoma Chapingo*, *Chapingo, Mexico*.

An establish cactus pear orchard can produce as much as 10 ton of cladodes ha-1 year-1 of pruning waste in the Pyramid's Region of Mexico State, representing approximately 175,000 ton of succulent material suitable for use as fodder. The objective of the present study was to evaluate the inclusion of pruning waste in sheep diets during winter to improve sustainability and profitability of the agricultural production systems. Seventy five heads (4 rams, 48 ewes, and 23 lambs) of the local "Criollo" breed were used. They were divided into four groups (one ram, 12 ewes and their six lambs) and randomly assigned to one of the following treatments: T1, total confinement with a complete diet (diet 1, 2 kg hd-1 day-1), T2, total confinement with a complete diet (diet 2, 1.6 kg plus 4.0 kg of cactus pear hd-1 day-1) fed at 08:00 and 16:00 h, T3, sheep ranged from 10:00 to 16:00 h, confined overnight and supplemented with 0.8 kg of diet 2 plus 2.0 kg of cladodes hd-1 day-1, T4, sheep ranged as T3 but supplemented with 2.0 kg of corn stover head-1 day-1 (traditional system). The experiment lasted 124 days. Average initial live weight was 549.5 ± 7.1 kg, and final live weight varied from 680.0 to 943.0 kg, treatments 4 and 1, respectively. The change in live weight was due to the increase in live weight of the adults and lambs as well as the new borns. However, the lowest feed cost resulting in T3 and T2, where cactus pear was included. It was concluded that the inclusion of cactus pear may represent an important alternative to utilize agricultural resources and increase animal production.

Key Words: Cactus Pear, Pruning Waste, Sheep

M164 Effects of the addition of *Saccharomyces cerevisiae* to sheep diets on productive performance and ruminal fermentation. I. Mejia-Haro*[1], E. Ortega-Perez[1], G. Tirado-Estrada[1], J. Mejia-Haro[2], and I. Castillo-Zuñiga[1], [1]*ITEL, AGUASCALIENTES*, *Aguascalientes, Ags. Mexico*, [2]*Universidad de Guanajuato*, *Irapuato, Gto. Mexico*.

The objective of this study was to evaluate the effects of the addition of *Saccharomyces cerevisiae* to sheep diets on productive performance, and ruminal fermentation. The study was carried out in two experimental periods. In period I, average daily gain, and feed efficiency were evaluated in 15 wethers sheep assigned to a completely randomized design where *Saccharomyces cerevisiae* was added to diet in three concentration- treatments (T1, 0%; T2, 1% and T3, 1.5% DM). In period II, the effects of the addition of *Saccaromyces servisae* to the experimental diet on in situ digestibility in six times of ruminal fermentation (0, 8, 12, 24, 48, and 72 h), free fatty acids, and NH3-N concentrations were evaluated. Data were analyzed by GLM procedure of SAS using ANOVA and Tukey test. In period I, T2 and T3 were higher (P<.05) than T1 in ADG (195, 226 and 115 for T2, T3, and T1, respectively, CV = 15%) and feed efficiency (kg of feed / kg BW of gain) was lower in T2 (4.7) than T1, and T3 (7.2 and 5.8, respectively). Values of in situ digestibility were higher in T2 and T3 (84, and 84%) than T1 (82%) at 72 h. The VFA and acetic and propionic concentration were higher (P<.05) in T3 (186, 124, and 33 mM for VFA, acetic, and propionic acid, respectively) than T1 (109, 69, and 20 mM, respectively) and T2 (115, 77, 20 mM, respectively); however, in the butyric acid concentration, the addition of Saccharomyces c. did not have any significant effect (20, 18, and 28 mM for T1, T2, and T3, respectively). In the NH3-N concentration, T3 was higher (53 mg/dL, P<.05) than T1 and T2 (22, and 30 mg/dL, respectively), which presented no differences. As a conclusion, the addition of *Saccharomyces cerevisiae* to sheep diets improved ADG and feed efficiency and produced changes in ruminal fermentation.

Key Words: ADG, Feed Efficiency, Digestibility

M165 Rumen fermentation parameters in sheep fed oat and bean straw-based diets. C. A. Anderson-Huerta, G. Nevarez-Carrasco, R. Montoya-Escalante, A. S. Juárez-Reyes, and M. A. Cerrillo-Soto*, *Universidad Juárez del Estado de Durango*, *Durango, Durango, México*.

Sheep represent an important potential for meat production in the semiarid regions of North Mexico. Common agricultural by-products in such areas are oat and bean straw which are utilized after prolonged dry periods. Thus, a study was conducted to estimate the effect of oat and bean straw-based diets on rumen VFA, Ammonia-N and pH. Five rumen cannulated criollo sheep (45 ±4.5 kg BW) were used to obtain rumen fluid samples at 0, 2, 4, 6, 8 an 10 h after feeding. Treatments consisted of 70% oat straw (T1); 40% oat straw (T2), 70% bean straw (T3); 40% bean straw (T4); and a control with 50% oat straw and 50% bean straw (T5). Other ingredients were alfalfa hay, ground corn and cotton seed meal. Diets were isonitrogenous (11% CP). Each period of the trial consisted of a 14-day adjustment and a 5-day collection phases. Ammonia-N concentrations were determined by the hypochlorite procedure using spectrophotometry. Volatile fatty acid concentrations were estimated by gas chromatography. Data were analyzed using Proc GLM for a Latin Square Split-Plot Design. Ammonia-N concentrations ranged from 5.38 to 7.61 mg/dl for T3 and T5, respectively and were similar between treatments (P>0.05). Values for pH were also similar in animals fed the treatments (mean 6.56: P>0.05). Treatments resulted in marginal differences in VFA concentratios among treatments (P=0.056). A numerical increment (P<0.10) in acetate concentrations was registered in sheep fed T5 which produced 27.5% more acetate than their counterparts fed T1. No differences in propionate concentrations were registered between treatments (P>0.05), although animals fed T5 produced 32.5% more propionate than the animals receiving T1. Butyrate levels followed the same trend (P>0.05). Data indicated that the diets produced enough ammonia-N to ensure an adequate microbial synthesis. Mean pH concentrations might not jeopardize ruminal cellulolysis. Volatile fatty acid concentrations in diets containing equal proportions of oat and bean straws, might evidence the importance of such by products when other source of food are scarce for sheep production.

Rumen fermentation parameters of sheep fed oat and bean straw-based diets.

	Treatments							
Item	1	2	3	4	5	Mean	sem	Significance
NH_3-N (mg/dl)	6.14	6.83	7.64	6.14	5.38	6.43	2.19	0.66
pH	6.59	6.55	6.61	6.47	6.46	6.56	0.13	0.54
Total VFA (mM^{-1})	31.2	33.7	40.2	36.9	44.1	37.2	8.72	0.05
Acetate (mM^{-1})	25.0	25.8	32.7	28.8	34.5	29.4	7.28	0.06
Propionate (mM^{-1})	2.38	3.28	2.62	2.89	3.53	2.90	0.95	0.30
Butyrate (mM^{-1})	1.92	2.32	2.61	2.17	3.12	2.43	0.57	0.24

Key Words: Fermentation Parameters, Sheep, Straw diets

M166 Effects of supplementation of two selenium sources in productive performance of growing sheep. I. Mejia-Haro*[1], A. R. Rodriguez-Murillo[1], G. Tirado-Estrada[1], R. Bañuelos-Valenzuela[2], J. Mejia-Haro[3], and J. A. Nungaray-Ornelas[1], [1]*ITEL, Ags.*, *Aguascalientes, Ags., Mexico*, [2]*Unidad Academica de Medicina veterinaria y Zoot., UAZ*, *Calera, Zac., Mexico*, [3]*Universidad de Guanajuato*, *Irapuato, Gto., Mexico*.

The objective of this study was to compare the supplementation of two sources of selenium in response to sheep performance. Twenty-four Pelibuey sheep (X= 20.5 kg of body weight), after the adaptation period were assigned in a completely randomized design to 1 of 3 treatments for a three-month study; T1, basal diet without selenium supplementation; T2, basal diet plus 1 ppm of organic selenium (Sel-Plex of All Tech lab) and T3, basal diet plus 1 ppm of selenium- yeast (Vitamin World, used in human nutrition). The evaluated variables were average daily gain, feed conversion and selenium content in hair samples. Data were analyzed by GLM procedure of SAS using ANOVA and comparison of means by tukey test. The treatment containing the diet supplemented with Selenium-yeast (T3) had higher (p<.05) daily gain (211 g) than the control group (162 g) and T2 (193 g). Feed conversion was lower (P<.05) in T3 (4.9 kg of feed/ kg gain of weight) than T2 and T1 (5.3 and 6.3 kg of feed/kg BW, respectively). Selenium content of hair was higher (P <.05) in T3 (.83 ppm) than T2 and T1 (.65 and .56 ppm, respectively). It was concluded that source of selenium supplementation influences average daily gain and feed conversion and supplementing selenium-yeast produced a better response in these parameters than not supplementing or supplementing Sel-Plex.

Key Words: Selenium, Minerals, Deficiency

M167 Toxicological study of gandul forage (Cajanus cajan). M. Duron-Velazquez[1], G. Tirado-Estrada*[1], I. Mejia-Haro[1], F. Jaramillo-Juarez[2], R. Larios-Gonzalez[1], H. Silos-Espino[1], and F. Nieto-Muñoz[1], [1]*ITEL, Ags., El Llano, Ags. Mexico*, [2]*Universidad Autonoma de Aguascalientes*, *Aguascalientes, Ags., Mexico*.

The objective of this study was to evaluate the toxicological content of gandul forage in vitro and in vivo in wethers sheep, two stages were carried out, the first one consisted in the in vitro evaluation of gandul forage, in which tannins (colorimetric method of Folin-Dennis and saponines (level of color intensity, method of thin layer chromatography) were analyzed in four sampling sites (S1, S2, S3 and S4) dividing the plant in three vegetative strata in each site (bottom = EB, medium = EM, top = EA), and three different ages (young plants = PJ, medium = PM and mature = PA). The saponines analysis also was carried out in flowers of the sites 2, 3 and 4 (FS2, FS3 and FS4). The second stage consisted in observe signs of toxicity in 20 sheep (18 kg BW) fed diets with different concentrations of gandul (0, 15, 30, 45 and 60 % of DM for T1, T2, T3, T4 and T5, respectively) and assigned to one of five treatments in a completely randomized design and evaluated by GLM of SAS using ANOVA and tukey tests. Blood samples were collected to determine albumin and transaminases concentrations (aspartate aminotransferase = GOT, and alanine aminotransferase = GTP). Also, liver samples were collected to carry out a histological study, for which, five wethers, one of each treatment were sacrificed. The results indicated no toxicity. In the first stage, the highest value of tannins (gTA equivalents) was for PM (12.52), followed by S1EB (11.86) and the lowest value for PJ (2.71), the average value (7.9) was below 8, which is considered a marginal value of toxicity . For saponines, the highest value was for S1EB and S1EM, otherwise, in FS4 and PJ, saponine presence was not observed. T5 obtained the highest serum albumin concentration (7.084 u/l). For GOT, T3 obtained the highest value (38.72 u/l) and the lowest value for T4 (25.4 u/l), likewise, for GTP, the highest value was obtained by T3 (61.7 units) and the lowest by T2 (21.1 units). In liver, all samples presented a normal histological organization. In the in vivo study, no toxicity was present; ADG, and feed intake were adequate for all treatments. Gandul forage did not present toxicity in in vivo and in vitro studies.

Key Words: Saponines, Tannins

M168 Characterization of a negative halothane gene commercial multibreed swine population for growth and conformation traits in tropical western Thailand. S. Koonawootrittriron[1], M. A. Elzo*[2], and T. Suwanasopee[1], [1]*Kasetsart University*, *Bangkok, Thailand*, [2]*University of Florida*, *Gainesville*.

The Thai market demands lean pork. Producers are attempting to meet this demand by breeding pigs of larger size and lean content. Pietrain is one of the major breeds used to achieve this goal. Unfortunately, Pietrain has a high frequency of halothane (i.e., porcine stress syndrome) genes that can produce low quality meat and death by heat stress under conditions of high temperature and humidity. The objective of this research was to evaluate a large commercial negative halothane gene multibreed swine population in western Thailand for growth and conformation traits. Breeds represented were Pietrain (P), Large White (LW), and Landrace (L). Boars from all breeds were mated to P sows. LW females were only used to produce replacement boars. This mating strategy resulted in 4 breed groups of piglets: P, L, F1 LW×P, and F1 L×P. Pigs were kept in open barns, and received the same nutrition, management, and health care. Data consisted of 37,628 birth weights (BW) and 12,404 weaning weights (WW), and 2,980 body lengths (BL), shoulder widths (SW), hip widths (HW) and ages at first estrus (AE) from pigs born from 2003 to 2006. Genetic parameters and estimated breeding values were computing using multivariate animal models (BW-WW and BL-SW-HW-AE). Fixed effects were contemporary group (year-month), sex, parity of dam, direct heterosis, and animal genetic group. Random effects were animal, dam (BW-WW only), and residual. Computations were performed using ASREML. All fixed effects were important for all traits ($P < 0.001$). Estimates of heritabilities for direct genetic effects were 0.09 ± 0.02 for BW, 0.08 ± 0.02 for WW, 0.13 ± 0.03 for BL, 0.18 ± 0.04 for SW, 0.15 ± 0.04 for HW, and 0.33 ± 0.06 for AE. Maternal heritabilities were 0.22 ± 0.01 for BW and 0.20 ± 0.01 for WW. Monthly phenotypic means tended to increase for BW, BL, and HW, and to decrease for AE. Monthly genetic means tended to increase for HW and to decrease for AE.

Key Words: Halothane, Pig, Tropical

Lactation Biology: Mechanisms Regulating Lactation and Mammary Function

M169 Effects of dietary supplementation with flax during prepuberty on mammary development and circulating prolactin and estradiol concentrations. C. Farmer*[1], H. V. Petit[1], and A. V. Capuco[2], [1]*Agriculture and Agri-Food Canada*, *Sherbrooke, QC, Canada*, [2]*USDA-ARS*, *Beltsville, MD*.

The possible role of dietary flax on mammary development of prepubertal gilts was investigated. Fifty-seven gilts were fed one of four diets from 88 d of age until slaughter (day 212 ± 1). Diets were: standard, CTL (n=14); 10% flaxseed supplementation, FS (n=13); 6.5% flaxseed meal supplementation, FSM (n=15); and 3.5% flaxseed oil supplementation, FSO (n=15). All diets were isonitrogenous, isolipidic and isocaloric. Jugular blood samples were obtained on days 78 and 210 and assayed for prolactin and estradiol. At slaughter, mammary glands were excised, parenchymal and extraparenchymal tissues were dissected and composition of parenchymal tissue was determined. Histochemical analyses of mammary parenchyma were performed and fatty acid profiles in extraparenchymal tissue were evaluated. Dietary flax increased ($P \leq 0.001$) the concentrations of polyunsaturated fatty acids (PUFA) and decreased those of saturated (SFA, $P < 0.01$) and monounsaturated (MUFA, $P < 0.001$) fatty acids in mammary extraparenchymal tissue. This was largely due to the inclusion of FS or FSO ($P < 0.01$), but not FSM. Circulating concentrations of prolactin and estradiol were unaltered by treatments ($P > 0.1$). Dry matter content of parenchymal tissue was the only mammary compositional value affected, showing an increase with flax addition ($P < 0.05$). Diet did not alter ($P \geq 0.1$) BrdU labelling index or estrogen receptor localization. Within mammary parenchyma, estrogen receptors were present in epithelial cells but not adipocytes, a novel demonstration of potential estrogen targets in gilt mammary gland. Dietary supplementation with flax as seed, meal or oil, brought about expected changes in fatty acid profile in mammary extraparenchymal tissue but neither the alteration in fatty acid profile nor the presence of lignans had beneficial effects on hormone concentrations or mammary development.

Key Words: Flax, Mammary Development, Swine

M170 Developmental changes in the milk fat globule membrane proteome during the transition from colostrum to milk. T. A. Reinhardt* and J. D. Lippolis, *National Animal Disease Center, ARS, USDA*, *Ames, IA*.

Shotgun Proteomics, using amine-reactive isobaric tags (iTRAQ) was used to quantify protein changes in milk fat globule membranes (MFGM) that were isolated from day 1 colostrum and compared to MFGM from day 7 milk. Eight Holstein cows were randomly assigned to 2 groups of 4 cow sample pools for a simple replication of this proteomic analysis using iTRAQ. iTRAQ labeled peptides from the experiment sample pools were fractionated by strong cation exchange chromatography followed by further fractionation on a micro-capillary high performance liquid chromatograph connected to a nanospray-tandem mass spectrometer. Data analysis identified 138 bovine proteins in the MFGM with 26 proteins up-regulated and 19 proteins down-regulated in day 7 MFGM compared to colostrum MFGM. Mucin 1 and 15 were up-regulated greater than 7 fold in MFGM from day 7 milk compared to colostrum MFGM. The tripartite complex of proteins of adipophilin, butyrophilin and xanthine dehydrogenase were individually upregulated in day 7 MFGM 3.4, 3.2 and 2.6 fold respectively compared to colostrum MFGM. Additional proteins associated with various aspects of lipid transport, synthesis and secretion such as acyl-CoA synthetase, lanosterol synthase, lysophosphatidic acid acyltransferase, and fatty acid binding protein were up-regulated 2.6 -5.1 fold in day 7 MFGM compared to colostrum MFGM. In contrast, apolipoproteins A1, C-III, E and A-IV were down-regulated 2.6-4.3 fold in day 7 MFGM compared to colostrum MFGM. These data demonstrate that quantitative shotgun proteomics has great potential to provide new insights into mammary development.

Key Words: Proteomics, Milk Fat Globule Membrane, Lactation

M171 Temporal effect of *trans*-10, *cis*-12 conjugated linoleic acid on mammary lipogenic gene expression. J. K. Kay[1,2], C. E. Moore[1], D. E. Bauman[3], R. P. Rhoads[1], S. R. Sanders[1], A. F. Keating[1], and L. H. Baumgard*[1], [1]*University of Arizona*, *Tucson*, [2]*Dexcel*, *Hamilton, New Zealand*, [3]*Cornell University*, *Ithaca*.

Trans-10, *cis*-12 conjugated linoleic acid (CLA) reduces milk fat synthesis and mammary lipogenic gene expression in lactating dairy cows. It is unknown however, if these genes are collectively down regulated by a global nuclear transcription factor or if one key enzyme is directly affected and reduction in other lipogenic genes is due to lack of substrate (i.e. malonyl CoA) availability/requirement, or an alternative indirect mechanism. We investigated the temporal effects (0, 12, 24 and 72 h) of intravenous (IV) *trans*-10, *cis*-12 CLA infusion (13.1 g *trans*-10, *cis*-12 CLA/d) on mammary acetyl CoA carboxylase (ACC), fatty acid synthetase (FAS), Δ*9*-desaturase (SCD), and fatty acid binding protein (FABP) mRNA abundance. Dry matter intake, milk yield and yield and content of milk protein and lactose were not affected by CLA infusion. However, CLA infusion progressively reduced milk fat content and maximum milk fat depression (MFD; 49%; $P<0.05$) occurred at 72 h. Overall mRNA expression of ACC and FAS decreased ($P<0.05$) and SCD tended to decrease ($P<0.09$) but FABP was not altered by CLA infusion. By 24 h post infusion initiation, ACC mRNA abundance was reduced ($P<0.05$) by 44% while FAS and SCD tended to be reduced ($P<0.08$) by 47 and 46%, respectively. At 72 h, magnitude of reduction and level of significance did not alter from the 24 h time point even though MFD continued to progress. The similar temporal effects of *trans*-10, *cis*-12 CLA on ACC, FAS and SCD mRNA abundance suggests these lipogenic genes are down regulated collectively by *trans*-10, *cis*-12 CLA, probably via a global modulator, rather than inhibition of a specific key lipogenic gene.

Key Words: CLA, Milk Fat, Gene Expression

M172 Expression profiling of proteins involved in CLA metabolism in mammary tissue and mammary gland epithelial cells. Y. C. Jin[1], H. G. Lee*[1], J. A. Han[1], J. H. Li[1], K. H. Kim[1], N. K. Lee[1], Y. J. Kim[2], M. K. Song[3], and Y. J. Choi[1], [1]*School of Agricultural Biotechnology, Seoul National University*, *Seoul, Korea*, [2]*Department of Food Science & Biotechnology, Korea University*, *Chochiwon*, [3]*Department of Animal Science, Chungbuk National University*, *Chungbuk, Korea*.

This study was conducted to observe proteins involved in CLA metabolism comparing the difference of protein expression among control (no additional fatty acid), vaccenic acid (trans-11 C18:1, a precursor for CLA biosynthesis) and CLA i.v. infusion in the abdomen of 9 lactating rats. The rats were perfused with 120ml of heparinized DMEM. The mammary tissue samples were biopsied by surgical biopsy instrument in lactating rats. Likewise we sought to compare the difference of protein expression among control (BSA), vaccenic acid and CLA added to the medium of differentiated HC11 cells. The protein samples of the mammary tissue and epithelial cells were analyzed by two-dimensional electrophoresis. We identified the specific spots using ESI-Q-TOF and a protein search engine. In rats, vaccenic acid treatment increased the level of cis-9, trans 11 CLA and vaccenic acid in mammary tissue. In addition, CLA treatment increased the level of trans-10, cis-12 CLA and cis-9, trans-11 CLA in mammary tissue ($P<0.05$). The most striking differences in protein abundance between the control and vaccenic acid treatment were seen in 5 specific spots, and 7 spots were detected between saline and CLA treatment. Likewise in HC11 cells, the most striking differences in protein abundance between the control and vaccenic acid treatment were seen in 3 specific spots and 2 spots were detected between BSA and CLA treatment. So we examined the expression of mRNA in the mammary tissue and epithelial cells by real-time PCR, which substantiated 4 genes differentially expressed overall in mammary tissue and epithelial cells. Our results suggest that the identified proteins may be related to CLA biosynthesis and apoptosis of the mammary tissue induced by CLA.

Key Words: Conjugated Linoleic Acid, Mammary Gland, Proteomics

M173 Effects of heat stress vs. underfeeding on milk fatty acid composition. M. D. O'Brien*, J. B. Wheelock, A. J. La Noce, M. L. Rhoads, R. P. Rhoads, M. J. VanBaale, R. J. Collier, and L. H. Baumgard, *University of Arizona*, *Tucson*.

Determining heat stress (HS) effects on lactation variables is complex as they are confounded with reduced nutrient intake. To separate the differences between HS and decreased feed intake on milk fatty acid composition, we conducted two HS experiments (EXPS) where a thermal-neutral (TN) control group was pair-fed to match nutrient intake with the heat-stressed cows. In both EXPS, the diet was similar and consisted primarily of alfalfa hay and steamed-flaked corn. HS conditions were cyclic to mimic an AZ July day, with temperatures

ranging from 29.7 to 39.2°C. After a TN period of ad libitum feed intake, cows entered HS or underfeeding (UF) periods which lasted for either 9 d (exp 1; n = 12) or 7 d (exp 2; n = 24). In both EXPS rectal temperature increased during HS (averaging 40.5°C at 1400 hr) while DMI decreased by ~30%. By design, UF cows had similar intakes while still producing more milk (> 7 kg/d) indicating UF accounts for only ~50% of HS-induced decreased milk yield. There were little differences in milk fatty acid parameters between experiments, therefore main effects of HS and UF are presented. Milk fat content did not differ (3.73) between treatments. Compared to UF, HS decreased (>10%) the MUFA and PUFA content and increased the saturated fatty acid content of milk fat. Specifically, HS decreased the content of 18:2, 18:3, 18:1 *trans*-6-8, 18:1 *trans*-9 and 18:1 *trans* -11 and increased biohydrogenation end products (18:0 & 16:0), but had no effect on 18:1 *trans*-10 and 18:1 *trans*-12. HS decreased the Δ^9-desaturase index (34.9 vs. 39.4) and reduced the milk fat *cis*-9, *trans*-11 CLA content (2.97 vs. 5.16 mg/g). On a fatty acid origin basis (as a % of total molar yield), HS increased the contribution of 16:0 and 16:1, but *de novo* and preformed derived fatty acids did not contribute differently between treatments. Independent of reduced feed intake, HS markedly effects milk fatty acid composition and this is characterized by a decrease in PUFA and most biohydrogenation intermediates with a corresponding increase in the resulting saturated end products.

Key Words: Heat Stress, Milk Fatty Acids, Biohydrogenation

M174 Stearoyl-CoA desaturase gene expression and fatty acid concentrations in bovine tissues. E. Mosley, B. Hatch, K. Hunt, A. Morrison, C. Roberts, D. Sevier, and M. McGuire*, *University of Idaho*, *Moscow*.

The stearoyl-CoA desaturase (SCD) enzyme is important in maintaining lipid fluidity. However, the relationship between the level of gene expression and activity of the SCD enzyme is not well defined. The objective of this study was to determine if there was an association between the basal gene expression of SCD and occurrence of the products of SCD (14:1c9, 16:1c9, 18:1c9, and 18:2c9t11) in various tissues. Samples were obtained from animals (2 lactating Holstein cows and 2 mixed breed market steers) at slaughter. Heart, skeletal muscle, liver, lung, rumen, large intestine, small intestine, intestinal adipose, and mammary (cows only) samples were frozen in liquid nitrogen and stored at -80°C. RNA was extracted and converted to cDNA for quantitative real time PCR analysis of the SCD gene. Extracted lipid was converted to fatty acid methyl esters and analyzed by gas chromatography. In descending order, intestinal adipose, mammary, lung, heart, and small intestine tissues had the highest expression of SCD (3,037,718 ± 1,989,208; 1,468,529 ± 199,409; 1,319,235 ± 403,596; 1,123,247 ± 345,633; and 931,783 ± 250,632 copies/100 ng RNA, respectively), while skeletal muscle, large intestine, rumen, and liver tissues contained lower levels of expression (519,809 ± 142,239; 385,048 ± 232,297; 359,063 ± 54,836; and 354,244 ± 156,812 copies/100 ng RNA, respectively). Considerable variation was detected among animals independent of gender (cow vs steer). The desaturase indices for each substrate of SCD (product/(substrate+product)) were similar across tissues. There was an inverse correlation ($r = -0.79$, $P < 0.0001$) between total PUFA and total SCD product concentrations across all tissues. No relationship was detected between the level of gene expression and occurrence of SCD fatty acid products in tissues or desaturase indices. A greater understanding of the regulation of tissue fatty acids is necessary.

Key Words: Stearoyl-CoA Desaturase, Real Time PCR, Fatty Acid

M175 Expression of PPAR and LXR nuclear hormone receptor families are not modified during milk fat depression induced by diet or treatment with trans-10, cis-12 conjugated linoleic acid (CLA). K. J. Harvatine* and D. E. Bauman, *Cornell University*, *Ithaca, NY*.

Milk fat synthesis can be inhibited by intermediates of ruminal fatty acid biohydrogenation including trans-10, cis-12 CLA. These biohydrogenation intermediates signal a coordinated down-regulation of genes involved in mammary fatty acid synthesis, transport and esterification. We have previously reported decreased expression of SREBP1, SREBP1 activating proteins and Spot 14 during diet-induced milk fat depression and treatment with trans-10, cis-12 CLA. Regulation of nuclear hormone receptors (NR) during milk fat depression is of interest as NR are key regulators of lipogenic genes and CLA is known to modify expression and activation of some NR. Tissue profiling identified only LXRalpha as responsive to lactation with increased expression in lactating compared to nonlactating mammary tissue. Expression of NR and NR responsive genes during milk fat depression was investigated by Real-Time PCR using mammary tissue of cows during diet-induced milk fat depression (low forage, high oil diet: LF/HO) and 3d intravenous infusion of trans-10, cis-12 CLA (10 g/d). The LF/HO diet and CLA treatment reduced milk fat yield by 38 and 24%, respectively. Expression of PPARalpha, beta and delta was not modified by treatment. Expression of mitochondrial fatty acid oxidation enzymes (CPT1a and ACADVL) was increased approximately 50% by LF/HO treatment but expression of a peroxisomal oxidation enzyme (ACOX) was unaffected. Expression of LXRalpha and beta and the LXR responsive gene ABCA1 was not modified by treatment. Some members of the LXR and PPAR gene families are expressed in the lactating mammary gland; however, their expression is not modified during diet or trans-10, cis-12 CLA induced milk fat depression.

Key Words: Nuclear Receptors, Milk Fat Synthesis, Lipogenesis

M176 Production and physiological indicators to select pasture-based dairy cows suitable for extended lactations. J. K. Kay, P. W. Aspin, C. V. C. Phyn, J. R. Roche, D. A. Clark*, and E. S. Kolver, *Dexcel*, *Hamilton, New Zealand*.

In pasture-based systems cows are traditionally managed to calve seasonally and annually in order to maximize pasture utilization. Increased productivity and declining reproductive performance has led to the incorporation of longer calving intervals and extended lactations, however, individual cows vary in their ability to maintain milk production for an extended lactation. Identifying production and physiological markers to predict suitable cows for extended lactations would allow dairy farmers to make early decisions to withhold mating or to continue milking specific non-pregnant cows through the typical dry months. Fifty-six genetically divergent North American and New Zealand Holstein Friesians were allocated to three pasture-based dietary treatments (0, 3 and 6 kg concentrate DM/cow/d), and breeding was withheld to target a 600 d lactation. Within each treatment (genotype × diet), milk solids (MS; protein + fat) yield during the extended lactation (>296 DIM) was positively correlated with MS yield from the previous season ($P < 0.05$; $r^2 = 0.15$), MS yield from the first 296 DIM ($P < 0.01$; $r^2 = 0.19$) and daily MS yield at a theoretical dry-off date (~296 DIM; $P < 0.01$; $r^2 = 0.43$). In contrast, MS yield during the extended lactation was negatively correlated with BCS at theoretical dry-off ($P < 0.01$; $r^2 = 0.37$). Hormone and metabolite data from wk

1-10 post-partum demonstrated a positive association ($P < 0.01$; $r^2 = 0.24$) between NEFA levels and extended lactation MS production, whereas glucose, insulin, and IGF-I were negatively associated ($P < 0.01$; $r^2 = 0.23, 0.37, 0.26$, respectively) with extended lactation MS production. Overall, milk production, BCS and early lactation hormone and metabolite data may be useful criteria to identify animals that will undergo a successful extended lactation.

Key Words: Extended Lactation, Predictors

M177 Milk from cows at involution reduces MAC-T cell survival. G. Tremblay*[1], P. Bernier-Dodier[1], L. Delbecchi[2], G. F. Wagner[3], B. G. Talbot[1], and P. Lacasse[2], [1]*Université de Sherbrooke*, *Sherbrooke, QC, Canada*, [2]*AAFC-Dairy and Swine R&D Center*, *Sherbrooke, QC, Canada*, [3]*University of Western Ontario*, *London, ON, Canada*.

Several data indicate that mammary gland involution is under a local control. However, the exact nature of this control is still unknown. The objective of this experiment was to verify the presence of factors in milk that can reduce mammary cell survival during milk stasis. Milk samples were obtained from nine Holstein cows in late lactation that received a unilateral milking for 14 days. Left forequarter and right hindquarter were milked twice a day while the two other quarters were dried off (d 0). Milk samples were taken from forequarters on d -7, 1, 2, 7, and 14 for an *in vitro* assay. In the *in vitro* assay, milk samples were added to DMEM/F12 medium at a final concentration of 10% and incubated for 9 h with confluent MAC-T cells. Survival was quantified by the metabolic turnover of tetrazolium salt (XTT). The assay showed a ~98% survival for each milk sample except those from dry quarters on d 7 and 14, which showed a reduction of cell survival to 83.7% ($P < 0.001$) and 74.8% ($P < 0.005$), respectively, in comparison with cells incubated with milk from milked quarters at d 14. These results suggest that milk from dry quarters contains a factor able to reduce cell survival. Among the factors present in milk, stanniocalcin (STC) increased ($P < 0.001$) 2.5- and 3.2-fold after 7 and 14 d of milk stasis, respectively. There was a negative correlation (Pearson coefficient of -0.605) between STC concentration in milk and cell survival. Stanniocalcin is involved in the homeostasis of calcium and has been reported to induce apoptosis in chondrocytes *in vitro*. Even if the exact contribution of this hormone in the involution process is not known, its role in cell death has to be further investigated.

Key Words: Stanniocalcin, Mammary Gland, Involution

M178 Different milking frequencies alter stanniocalcin content in cow's milk. P. Bernier-Dodier*[1], P. Lacasse[2], G. F. Wagner[3], B. G. Talbot[1], and L. Delbecchi[2], [1]*Université de Sherbrooke*, *Sherbrooke, QC, Canada*, [2]*AAFC-Dairy and Swine R&D Center*, *Sherbrooke, QC, Canada*, [3]*University of Western Ontario*, *London, ON, Canada*.

Several lines of evidence suggest that there is a factor in milk that exerts a local control on lactation and mammary gland involution. Previously, we have shown that estradiol reduces milk production and increases the expression and concentration of stanniocalcin (STC) in the mammary gland of cows. We hypothesized that this hormone may be implicated in the involution process. To verify this hypothesis, we modulated the involution rate by manipulation of the milking frequency. Ten Holstein cows in mid-late lactation were differentially milked, two quarters being milked once daily and the two others thrice daily for 8 weeks. Milk samples were taken from forequarters every week to determine the STC content (RIA), the BSA content (colorimetric assay), and the protease activity (zymography). A significant difference in milk yield ($P < 0.0001$) was observed during the treatment between the thrice daily milked glands (increase) and the once daily milked glands (decrease). Milk yields (kg/d) were 12.6, 8.0, 6.5, and 8.8 for once daily milked glands, and 13.5, 16.3, 16.2, and 14.6 for thrice daily milked glands, on weeks 0, 4, 8, and 10 (week 2 post-treatment) respectively. At week 4, a higher rate of apoptosis was observed in the glands milked once daily compared with the glands milked thrice daily (0.83% and 0.38% respectively; $P < 0.05$), as detected by TUNEL analysis. This effect on apoptosis was not detected at week 8. In the majority of the cows (7 out of 10), zymographic analyses showed an increase in protease activity only in the milk from once-daily milked quarters, indicating an active remodelling of these glands. Milk BSA concentration was significantly increased in the once-daily milked quarters ($P < 0.001$), an augmentation possibly caused by an opening of the tight junctions in those quarters. Finally, milk STC concentration increased in all quarters during the treatment ($P < 0.001$); however, this increase was higher in the once-daily milked quarters than in the thrice-daily milked ones ($P < 0.01$). Our data indicate that milking frequency alters milk STC concentration and that this effect may be related to gradual involution of the mammary gland.

Key Words: Mammary Gland, Involution, Stanniocalcin

M179 Reduced nursing frequency decreases milk output and alters SOCS and TPH1 gene expression in the mouse mammary gland. W. Olea*, D. Torres, J. George, and D. L. Hadsell, *Baylor College of Medicine*, *Houston,TX*.

Reduced milking frequency in cows lowers milk production. In rats decreased nursing frequency below 4 times daily causes mammary involution. The mechanism by which this effect occurs is poorly understood. Recent studies in cows have shown that suppressors of cytokine signaling (SOCS) are regulated by milking frequency. The hypothesis for this study was that decreased nursing frequency in lactating mice would decrease milk production and increase mammary expression of SOCS genes and other negative feedback regulators of lactation. To test this hypothesis milk output and mammary gene expression was measured in dams that were allowed to nurse either ad-libitum (AL) or four times daily (4X). On day 1 of lactation, groups of CD-1 dams (10 mice /treatment) were given weight-normalized litters of 10 pups each. On day 8 postpartum the interval nursing was started in the 4x group. For this group the dams were given 4 1-hour nursing periods with their litters over a 24 hour period (5am, 11am, 5pm, and 11pm). Litter weight was measured daily. On day 14 post partum, milk production was measured in both groups by the weigh-suckle-weigh method after a 5 hour period of separation from the litters. Mammary tissue was then collected for analysis. Total RNA prepared from the inguinal mammary gland was analyzed for α-lactalbumin, lactoferrin, SOCS1, SOCS2, SOCS3, Cish, and TPH1 mRNA abundance using RT-qPCR. Milk output was lower ($P<0.05$) in 4X than AL (0.45±0.12g and 1.09±0.15g, respectively) but mammary morphology appeared similar between 4X and AL. Abundance of the mRNAs for α-lactalbumin, lactoferrin, SOCS2, and TPH1 was higher ($P<0.05$) in 4x than AL. Abundance of the mRNAs for SOCS1 was lower ($P<0.05$) in 4X than AL. Abundance of the mRNAs for SOCS3

and Cish were similar among 4X and AL. These results suggest that altered gene expression for SOCS1, SOCS2 and TPH1 in the mammary gland may mediate the loss of milk production that occurs with reduced nursing frequency in mice.

Key Words: Lactation, Milking Frequency, SOCS

M180 Gene expression profiling in bovine mammary gland during onset of lactation. K. A. Finucane[1], T. B. McFadden[1], J. P. Bond[1], J. J. Kennelly[2], and F.-Q. Zhao*[1], [1]*University of Vermont*, *Burlington*, [2]*University of Alberta*, *Edmonton, Alberta, Canada*.

The mammary gland undergoes dramatic functional and metabolic changes during the transition from late pregnancy to lactation. To better understand the molecular events underlying these changes, we analyzed expression profiles of approximately 23,000 gene transcripts in bovine mammary gland at day 5 before parturition and day 10 after parturition. A total of 1531 transcripts were significantly up-regulated while 2910 transcripts were down-regulated ($P < 0.05$). Gene ontology analysis showed that the main up-regulated genes were associated with transport activity (amino acid, nucleotide, glucose and ion transporters), lipid and carbohydrate metabolism (lipoprotein lipase, acetyl-Coenzyme A synthetase and carboxylase, 6-phosphofructo-2-kinase, etc.), and regulation of transcription and translation (transcription factor-like 1, CBP/p300-interacting transactivator, tRNA synthetase, etc.) while the main down-regulated genes were associated with cell cycle and proliferation (cyclins, cyclin-dependent kinase, etc.), protein and RNA degradation (proteasomes, thiolesterase, pinin, RNA binding motif protein, etc.), DNA replication and chromosome organization (histone, histone deacetylases, DNA polymerase accessory subunit, etc.) and microtubule-based processes (microtubule associated protein tau, kinesin, tubulins, etc.). The increased ($P < 0.05$) expression of glucose transporter GLUT1 mRNA during lactation was verified by quantitative reverse transcription/PCR. GLUT1 protein also tended to increase during lactation ($P = 0.13$). Furthermore, GLUT1 protein was primarily localized in mammary ductal epithelia and blood vessel endothelia before parturition, but was predominantly localized in the basolateral and apical membranes of mammary alveolar epithelial cells during lactation. Our microarray data provide insights into the molecular events in the mammary gland at the onset of lactation, indicating the up-regulation of genes involved in milk synthesis concomitant with the inhibition of those related to cell proliferation.

Key Words: Functional Genomics, Microarray, Periparturition

M181 Co-localization of glucose transporter-1 and hexokinase-1 in response to lactogenic hormones and media glucose concentration in bovine mammary epithelial cells. M. Dai* and J. P. Cant, *University of Guelph*, *Ontario, Canada*.

Hexokinase (HK) catalyzes the first step in intracellular glucose metabolism. Prior experiments revealed that glucose transport across the plasma membrane of bovine mammary epithelial cells appears to involve translocation into an intracellular compartment to which HK has access. The glucose transporter GLUT1 is the primary glucose transporter isoform expressed in bovine mammary gland during lactation. However, the isozyme of HK expressed in the bovine mammary gland remains unknown to date. Four isoforms of HK have been identified, and tissue-specific patterns of expression for the isozymes suggest unique roles for each in metabolism. In the present work, we tested the hypothesis that HK1 is expressed in bovine mammary gland, and co-localizes with GLUT1 in the presence of glucose and lactogenic hormones. Western blotting of mammary tissue with anti-HK1 revealed a band in the 75kDa region that is smaller than what has previously been reported for HK1 in other species. Confocal immunofluorescent microscopy of mammary epithelial cells revealed that co-localization of GLUT1 and HK1 is induced by lactogenic hormone complex (insulin, prolactin and hydrocortisone) at varied media glucose concentrations. Without lactogenic hormones, the immunofluorescent density of GLUT1 was low, and HK1 appeared not to co-localize with GLUT1 when media glucose concentration was increased to 25 mM. These results demonstrate that changes in GLUT1 expression and the co-localization of GLUT1 and HK1 in response to lactogenic hormones are consistent with the regulation of mammary glucose uptake and metabolism.

Key Words: Hexokinase, Glucose Transporter, Co-localization

M182 Presence of functional phosphodiesterases in dairy cow's mammary gland. V. Dostaler-Touchette*[1], C. Guillemette[2], F. J. Richard[2], and P. Y. Chouinard[1], [1]*Institut des nutraceutiques et des aliments fonctionnels, Université Laval*, *Québec, Québec, Canada*, [2]*Centre de recherche en biologie de la reproduction, Université Laval*, *Québec, Québec, Canada*.

One possible way to improve the secretion of milk constituents is to modulate cyclic nucleotide (cAMP, cGMP) pathways. Intracellular cyclic nucleotides are degraded by the enzyme family called phosphodiesterases (PDE). Previous studies have shown that using non-specific PDE inhibitors like caffeine improved milk production. The objective of this study was to investigate the critical role of PDEs in the lactation of dairy cows. In order to understand the enzymatic expression pattern in the mammary gland, tissue samples were taken randomly from an udder obtained from a local slaughterhouse. Using 1 μM of cAMP, PDE essays (n=5) reported a total activity of 45.5±5.5 fmol/min per μg of total protein. Rolipram, a specific PDE4 inhibitor, showed a sensible activity of 15.9±5.5 fmol/min/μg of total protein, supporting that PDE4 is responsible for one third of the total enzymatic activity in the mammary gland. Transcript analysis using RT-PCR revealed that PDE4D was amplified from specific primers designed from rat, mouse, human and validated with bovine. Expected size fragment was obtained in a 1% agarose gel. Sequence analysis of the amplicon resulted in 99% homology to PDE4D. It is therefore possible to give this subfamily the credit for the Rolipram-sensitive PDE activity in the cow's udder. Moreover, western blotting using a specific PDE4D antibody has confirmed that the protein of this isoenzyme is present. In conclusion, these results not only demonstrate the presence of PDE4D transcript and protein, but also show an active enzyme, suggesting a functional role of PDE4D in bovine mammary gland.

Key Words: Dairy Cow, Mammary Gland, Phosphodiesterase

M183 Modulation of cellular activity of glutathione peroxidase by L-selenomethionine in primary cultures of bovine mammary gland epithelial cells. S. G. Miranda*[1,2], Y. J. Wang[2], N. G. Purdie[2], V. Osborne[2], B. L. Coomber[2], and J. P. Cant[2], [1]*University of Zulia*,

Maracaibo, Zulia, Venezuela, [2]*University of Guelph*, *Guelph, Ontario, Canada*.

Cytosolic glutathione peroxidase (GPx1; E.C. 1.11.1.9) is a selenoenzyme that catalyzes the reduction of hydrogen peroxide, or organic hydrogen peroxides, and protects cells from oxidative damage. We have hypothesized that selenium supply influences mammary epithelial cell (MEC) survival by increasing GPx1 activity. A study was designed to evaluate the effect of L-selenomethionine (SeMet) on the activity of GPx1 in bovine MEC. Six Holstein lactating cows with udders free of infection were slaughtered and parenchymal tissue was harvested to prepare cells for primary culture. MEC were enzymatically monodispersed and collected by filtration. Western Blotting analysis detected GPx1 in the mammary parenchyma and MEC. Secretory cells were plated on collagen gel matrix in 24-well plates and fed with media which was replaced every 24 h. After reaching 80% confluence, MEC were incubated with media containing 0, 10, 20 or 50 nM SeMet for 3 d. GPx1 activity, total MEC and cell viability were recorded daily. Statistical analysis was carried out using one-way ANOVA with significance declared at $P<0.01$. Enzymatic activity of GPx1 in MEC increased linearly ($P<0.01$) as SeMet increased in the medium. Cells cultured in 20 and 50 nM SeMet had significantly higher ($P<0.01$) activity of GPx1 (46.3 ± 4.0, 46.3 ± 4.0 nmole NADPH/min per mg protein, respectively) than those in 0 and 10 nM SeMet (30.5 ± 4.0, 38.9 ± 4.0 nmole NADPH/min per mg protein, respectively). The total number of MEC (4.5×10^5) and their viability (91.7%) were significantly increased ($P<0.01$) in 50 nM SeMet *vs.* 0, 10, and 20 nM SeMet (2.4, 2.4, and 2.5×10^5, respectively, and 77.2, 79.4, and 80.5%, respectively). Results suggest that SeMet can increase the GPx1 activity, number and viability of lactating bovine MEC.

Key Words: Selenomethionine, Glutathione Peroxidase, MEC

M184 Prostaglandins A1 (PGA1) and E1 (PGE1) alter heat shock protein 70 (HSP-70) gene expression in bovine mammary epithelial cells (BMEC). J. L. Collier*[1], M. B. Abdallah[1], L. L. Hernandez[1], J. V. Norgaard[2], and R. J. Collier[1], [1]*University of Arizona*, *Tucson*, [2]*Danish Institute of Agricultural Sciences*, *Tjele, Denmark*.

PGA1 is known to induce heat shock protein (HSP) synthesis in a wide variety of mammalian cells resulting in protection against cellular stresses while PGE1 is associated with alteration of hypothalamic set point during fever. We tested the effects of PGA1 and PGE1 on HSP-70 gene expression in BMEC at thermoneutral (TN, 37°C) and during heat shock (HS, 42°C). Primary BMEC were cast in collagen gels using Dulbecco's Modified Eagle's media (DMEM) containing 10 ng/ml insulin, 25 ng/ml epidermal growth factor, 75 ng/ml insulin-like growth factor-1, 0.1% BSA and antibiotic/antimycotic at 37°C in 5% CO2. Cultures grew into ductal structures for 8 days with media changes at 48 hour intervals. On day 9 cultures were divided into 3 groups with Controls (C) receiving the growth media, another group received growth media containing 8ug/ml PGA1 and the final group received growth media containing 8ug/ml PGE1. Cultures were then equally divided and moved to TN or HS incubators for up to 16 h with samples removed at 0, 1, 2, 4, 8 and 16h. At each time point, 4 collagen cultures were pooled and immediately placed in TRIzol and stored at -80°C until extracted for RNA. Isolated RNA was evaluated by Nanodrop and was reverse transcribed into cDNA. Expression of HSP-70 was measured by real time-PCR using a Bio Rad IQ5 system with analysis by the delta delta CT method. Hypoxanthine phosphoribosyltransferase 1 (HPRT-1) was used as the housekeeping gene. Addition of PGA1 increased HSP-70 expression in both TN and HS at all time points with much greater expression differences detected during HS. Peak fold increases in HSP-70 expression over time zero for C and PGA1 in HS at 8 h were 16.3 vs. 122.3 ($P<0.0001$). Addition of PGE1 significantly reduced HSP-70 gene expression compared to C and PGA1 in both TN and HS at all time periods except 16h ($P<0.001$). At 16h, HSP-70 expression was higher in cultures containing PGA1 or PGE1 compared to C (2.2 and 0.8 vs. 0.5 fold over time zero; $P<0.03$). We conclude that PGA1 and PGE1 alter HSP-70 expression in BMEC in TN and HS environments.

Key Words: Heat Shock Protein 70, Gene Expression, Prostaglandins

M185 Suitability of foremilk somatic cell counts to estimate total quarter somatic cell count. O. Wellnitz[1], M. Woloszyn[2], and R. M. Bruckmaier*[1], [1]*University of Bern*, *Bern, Switzerland*, [2]*DeLaval International AB*, *Tumba, Sweden*.

In dairy practice, testing of quarter foremilk for the detection of mastitis (by California Mastitis Test (CMT) or by determination of somatic cell count (SCC)) is well established. However, the use of foremilk SCC to estimate total quarter SCC as a basis for calculation of whole udder and bulk tank SCC has not been systematically investigated. Therefore, a study was conducted in 19 dairy cows during 10 consecutive days, i.e. 20 consecutive milkings. Foremilk samples were taken from each quarter after a 1 min udder preparation for SCC measurement by a DeLaval cell counter (DCC). During machine milking, the whole milk of each quarter was collected separately and the SCC of each quarter milk was also determined and 1512 pairs of quarter recordings were evaluated by various linear regression analyses. Quarter milk SCC ranged from 2 to 3100 while foremilk SCC ranged from 5 to 5400 × 1000 cells/ml, respectively. The linear regression of foremilk and total quarter milk measurements of all quarters based on log10 SCC had a slope of 0.43 (R2=0.70). To characterize the predictability of total quarter milk SCC by foremilk measurements at different SCC levels, the samples were classified into different foremilk SCC (<20 (n=217), 20-50 (n=419), 50-100 (n=300), 100-300 (n=373), 300-500 (n=99), and > 500 (n=111) × 1000 cells/ml). The percentage of quarters with numerically higher SCC in the total milk than in the foremilk were 70.5, 46.3, 42.0, 23.3, 19.2, and 6.3% in the groups with foremilk levels of <20, 20-50, 50-100, 100-300, 300-500, and >500 × 1000 cells/ml, respectively. The regression coefficients ($p<0.001$) in these groups were 1.54, 1.05, 1.01, 0.75, 0.67, and 0.44, respectively. In conclusion, whole quarter SCC is higher than foremilk SCC at very low SCC levels. At higher foremilk SCC, whole quarter SCC is mostly lower with an increasing difference between foremilk and whole quarter values.

Key Words: Somatic Cell Count, Foremilk

M186 17β-hydroxysteroid dehydrogenase and β-casein transcripts detected in bovine milk somatic cells. D. A. Pape-Zambito*[1], C. A. Gifford[2], T. L. Ott[1], and R. S. Kensinger[1], [1]*The Pennsylvania State University*, *University Park*, [2]*University of Idaho*, *Moscow*.

Bovine milk contains 17β-Estradiol (E2) but the origins of this E2 in milk are undefined. Because E2 is fat-soluble, E2 in milk may be due to passive diffusion of E2 from plasma. However, we showed

that milk E2 concentrations were lower than plasma concentrations in early pregnancy, but were higher than plasma E2 concentrations in late pregnancy. Limited literature is available on enzymes with the ability to convert estrone (E1) to E2 in the mammary gland. The objective of this study was to determine if somatic cells obtained from milk generate 17β-hydroxysteroid dehydrogenase (17β-HSD) mRNA. Production of β-casein (β-CN) mRNA was used to verify presence of mammary epithelial cells (MEC) in somatic cell samples. Primers specific for bovine β-CN, 17β-HSD 7 and 17β-HSD 12 were designed from known and predicted sequences in the NCBI database. Milk was collected from 9 Holstein cows: 3 from each trimester of pregnancy. Milk was centrifuged, fat removed, and the supernantant decanted. The cellular pellet containing somatic cells was washed with PBS and resuspended in Trizol reagent (Invitrogen). RNA was extracted and RT-PCR utilized to determine presence of transcripts for β-CN, 17β-HSD 7, and 17β-HSD 12. The PCR conditions were as follows: 95C for 5 min, 40 cycles of 95C for 30 s, 64C for 30 s, and 68C for 45 s, a final extension step at 68C for 10 min, followed by agarose gel electrophoresis. Milk somatic cells from all 9 cows expressed β-CN, indicating a MEC population. In addition, 17β-HSD 7 and 17β-HSD 12 sequences were detected in cells of cows from all trimesters of pregnancy. The PCR products were cloned, sequenced, and verified against the NCBI database. These data are consistent with the hypothesis that cells within the mammary gland are capable of converting E1 to E2. Additional experiments are needed to determine which cell type(s) express 17β-HSD transcripts from milk-derived somatic cells.

Key Words: Estradiol, Mammary Gland, Steroidogenesis

M187 Estimation of heritability, repeatability and genetic trend for milk yield of Iranian buffalo in Khuzestan province of Iran using a univariate repeatability animal model. H. Farhangfar*[1], B. Zinvand[2], and F. Amirlou Abolfathi[3], [1]*University of Birjand*, *Birjand, Iran*, [2]*Azad University of Shooshtar*, *Shooshtar, Iran*, [3]*Jihade Agriculture of Khuzestan*, *Iran*.

In order to estimate heritability, repeatability and genetic trend for milk yield (adjusted to 305,2x) a total of 1214 records from lactation 1 through 5 of 795 Iranian buffaloes calving from 1993 to 2003 and distributed in 189 herds in Khuzestan province was used. A univariate repeatability animal model was applied to analyze the records. In the model, fixed environmental factors were herd-year-month of calving (contemporary group), lactation order and age linear covariate nested in the lactation. Additive genetic and permanent environmental random effects were also included in the model. Additive genetic relationship among animals was partially complete due to major lack of sire or dam identification. Restricted maximum likelihood estimates of variance components were obtained (via Average Information algorithm) using WOMBAT software. The results obtained in the present study showed that heritability and repeatability of milk yield were 0.071 and 0.075 respectively. This indicates that there was not only low additive genetic but also low permanent environmental variation among animals over the first 5 lactations suggesting that temporary environmental variation made up a large proportion of total phenotypic variance. Based upon regression of average predicted breeding value of animals with records on year of first calving it was also revealed that there was no statistically significant genetic trend over the period of time.

Key Words: Genetic Parameters, Milk, Iranian Buffalo

National ADSA Production Division Graduate Poster Competition

M188 Effect of feeding two forages at two levels with and without Rumensin to high producing Holstein cows on animal performance. C. M. Martinez*, Y. H Chung, T. W. Cassidy, V. Ishler, K. S. Heyler, and G. A. Varga, *The Pennsylvania State University*, *University Park*.

Two studies were conducted to evaluate the effects of feeding corn silage (study I) or grass silage (Study II) based diets at two levels with and without Rumensin on DMI, milk production and composition and blood metabolites. In both studies, 8 multiparous high producing Holstein cows were used (BW=698 kg±16 and DIM=194 d±3 for study I; BW=656 kg±16 and DIM=124 d±3 for study II) in a replicated 4x4 Latin square design with a 2x2 factorial treatment arrangement to evaluate the effects of forage level with and without Rumensin supplementation (300 mg/cow/d, top dressed). In study I, diets were formulated to contain 50 or 60% forage (DM basis) in which corn silage comprised 70% and western hay comprised 30% of the total forage in the diet. In study II, diets were formulated to contain 50 or 55% forage (DM basis) in which grass silage comprised 55% and corn silage comprised 45% of the total forage in the diet. The length of each period was 4 wks and samples were collected during the last wk. Results from study I (corn silage based diet) showed that DMI was higher ($P < 0.01$) for the 50% forage diets (29.6 kg/d) compared to the 60% forage diet (28.3 kg/d). In study II, DMI was lower ($P < 0.05$) for cows that were supplemented with Rumensin when compared to cows with no supplementation (25.9 vs. 24.7 kg/d, respectively). Milk total solids% was reduced ($P < 0.05$) with Rumensin supplementation (11.8%) versus no Rumensin supplementation (12.3%). Milk urea nitrogen was higher ($P < 0.059$) for cows consuming the 55% forage diet (10.1 mg/dL) than for cows provided the 50% forage diet (8.81 mg/dL). Within each forage source, milk yield and fat corrected milk were not affected by forage level source or Rumensin in the diet (40.9 and 42.4 kg/d, for study I; 41.6 and 41.7 kg/d for study II, respectively). Data from these studies showed that higher forage inclusion in dairy rations can be attained without affecting milk production or major components such as milk fat or protein % for either corn silage or grass silage based diets. Rumensin supplementation may affect milk components and DMI depending on the level and type of forage fed.

Key Words: Rumensin, Forage Level, Silage

M189 Conjugated linoleic acids attenuate lymphocyte proliferation and interleukin-4 production in bovine peripheral blood mononuclear cells challenged with concanavalin-A. C. Caldari-Torres*, W. R. Collante, and L. Badinga, *University of Florida*, *Gainesville*.

During the perinatal period, immune functions such as lymphocyte response to mitogens and production of antibodies are depressed in dairy cows. The objective of this study was to examine the short-term effects of *cis*-9,*trans*-11 and *trans*-10,*cis*-12 isomers of conjugated linoleic acid (CLA) on lymphocyte proliferation, tumor necrosis

factor-α (TNF-α) and interleukin-4 (IL-4) production by mitogen-stimulated bovine peripheral blood mononuclear cells (PBMCs). In preliminary studies, bovine PBMCs were incubated in the absence (Control) or presence of concanavalin-A (ConA, 10 μg/mL), lipopolysaccharide (LPS, 10 μg/mL), or phytohemagluttinin A (PHA, 10 μg/mL) for 24 or 48 h. Proliferative and cytokine responses were measured using thymidine incorporation and enzyme-linked immunosorbent assays, respectively. Compared to untreated cells, proliferation and cytokine production were maximally stimulated ($P < 0.05$) by ConA within 48 h. Tumor necrosis factor-α (range 53 to 84 pg/mL; $P < 0.01$) and IL-4 (range 16 to 197 pg/mL; $P < 0.01$) concentrations increased linearly between 0 and 15 μg/mL of ConA. Co-incubation with linoleic acid (LA) and CLA greatly decreased lymphoproliferative (448 cpm > 239 cpm; $P < 0.01$) and IL-4 (580 pg/mL > 272 pg/mL; $P < 0.05$) responses to ConA in cultured PBMCs. There were no apparent differences in TNF-α response to ConA due to fatty acid treatment (119 pg/mL; $P = 0.68$). These in vitro studies provide no evidence for LA or CLA-mediated improvement of immune functions in cattle. Whether these findings reflect the physiological effects of these fatty acids in vivo warrants further investigation.

Key Words: CLA, Immune Response, Cattle

M190 Evaluation of *in situ* indigestible neutral detergent fiber as an internal marker to determine digestibility of nutrients. L. O. Chow*, C. Silveira, and M. Oba, *University of Alberta*, *Edmonton, Alberta, Canada*.

The efficacy of *in situ* indigestible neutral detergent fiber (ISIDF) as an internal marker was compared to the external marker ytterbium (Yb) in determining apparent total tract digestibility of nutrients. It was hypothesized that the *in situ* method would provide repeatable indigestible NDF measurements, and would be a reliable marker to estimate digestibility. In the first study, ISIDF concentrations were determined with triplicate samples of concentrate mix, silage, TMR, and feces incubated for 120h in the rumen of 3 lactating and 3 dry cows. The overall intra- and inter-assay CVs for ISIDF measurements were 2.9 and 6.9%, respectively. The inter-assay CV was lower for samples incubated in the rumen of early dry cows as compared to those at peak lactation (3.5 vs. 7.2%), which may be due to lower diurnal variation in ruminal fermentation. In the second study, apparent total tract digestibility using ISIDF was compared with that using Yb as an external marker. Feed and fecal samples were collected from a study evaluating two lots of barley grain cultivars at two dietary grain allocations using 8 cows in a duplicated 4x4 Latin square design with a 2x2 factorial arrangement of treatments. Apparent total tract DM digestibility estimated by Yb was greater than that estimated by ISIDF (65.8 vs. 61.1%; $p < 0.05$), suggesting that nutrient digestibility was either overestimated by the Yb method, underestimated by ISIDF, or both. However, standard errors of means for DM digestibility were smaller when ISIDF was used as a digestibility marker compared with Yb (0.9 vs. 1.3%), suggesting that fecal DM flow was estimated more precisely using an 120h ISIDF as a marker. Though external markers such as Yb are used extensively to estimate flow of duodenal digesta or feces, their use requires extra labor for the frequent dosing of markers. The alternative of using the in situ method provides repeatable ISIDF measurements and is a reliable marker to estimate nutrient digestibility.

Key Words: *In Situ* Indigestible Neutral Detergent, Internal Marker, Apparent Total Tract Digestibility

M191 Producer perceptions of feed management software. B. G. Cox*, R. E. James, K. F. Knowlton, M. L. McGilliard, and C. C. Stallings, *Virginia Polytechnic Institute and State University*, *Blacksburg*.

Nine Virginia dairy farmers were surveyed in December 2006 to ascertain satisfaction with feed management software after at least 2 mo of use. Each received a subsidy (20%), installed feed management software (TMR Tracker ™, Digi-Star LLC, Fort Atkinson WI), and participated in a 24-question personal interview addressing installation, operation, and satisfaction with the software. Herd size ranged from 135 to 450 lactating cows, averaging 271 lactating cows producing 30 kg/cow/d. Number of TMR mixer operators per farm varied from 1 to 5, with 2 or 3 on 5 farms. Number of feeding groups per farm ranged from 1 to 3; 5 farms feeding 2 groups and 3 farms feeding 1 group. All participants reported that the software met expectations and, if given the choice, they would invest again. Despite satisfaction, 4 of 9 were uncertain or would not purchase the software without the subsidy provided by the project. All but one perceived feed management software as economically beneficial. All farms utilized the software to monitor operator performance and saw no change in quantity of feed purchased. Five producers noted improvements in ration consistency following use. Change made to the feeding program due to TMR Tracker correlated (r=0.80) with improvement in ration consistency. More than half (5 of 9) claimed employee training as the most challenging aspect of implementing TMR Tracker. The obstacle to viewing reports was dedication of adequate time. Forty-four percent of respondents attributed most problems to operator error. Overall, producers perceived feed management software as a beneficial subsidized investment with most problems arising from inexperience.

Key Words: Feed Management Software, Precision Feeding, Survey

M192 Out wintering pad design affects woodchip condition. K. O'Driscoll*[1,2], L. Boyle[1], P. French[1], B. Meaney[1], and A. Hanlon[2], [1]*Moorepark Dairy Production Research Centre*, *Fermoy, Co. Cork, Ireland*, [2]*University College Dublin*, *Dublin, Ireland*.

This study evaluated woodchip hygiene in 3 out-wintering pad (OWP) designs for spring calving dairy cows; uncovered [UP] and sheltered [SP] OWP where cows fed grass silage at a concrete feedface, and an OWP where cows self-fed silage on the woodchips [SF]. Cows were accommodated on each treatment in two replicates from Nov 05 until calving (mean=21 Feb 06). Cows on UP and SP had a woodchip space allowance of 12m^2 and on concrete of 2.52 m^2. The concrete was scraped 6 times per day. SF cows had a woodchip space allowance of 14.52m^2. OWPs were managed so that each cow had a minimum clean lying area of 2.2 m^2. OWPs were scored weekly using a visual dirt scale (DS) (1-4; 1=clean, 4=dirty) and composite woodchip samples were taken from the surface. Samples were analysed for dry matter (DM) and pH. Presence of bacteria (staphlococci, streptococci, coliforms) and bacterial load (no. colonies/agar plate) from each sample were determined using selective media. Data were analysed using SAS V9.1. A mixed model was used to analyse DS, DM and pH. Correlations between DS, no. weeks in use, and DM were investigated. Fishers exact test was used to investigate differences in species present and bacterial loads (low=<40 colonies, medium=>40, <200 colonies, high=>200 colonies) between treatments. UP and SF had higher DS scores than SP ($P<0.01$). DS increased with weeks in use ($P<0.001$). Woodchip DM was lower in UP and SF than in SP ($P<0.01$) and DM decreased with weeks in use ($P<0.001$). There was no effect

of treatment on pH, and although the effect of time was significant (P<0.05) there was no discernable pattern over time. There was a positive correlation between DS and weeks in use (P<0.001; r=0.764) and a negative correlation between DS and DM (P<0.001; r=-0.633). There was no difference between treatment samples in either presence or load of Staphylococci sp or in the number of samples per treatment that contained Streptococci spp, but SF had more samples with a high load (P<0.01). More samples from SF contained Coliform spp (P<0.05), due to a higher number of samples with a low and medium bacterial load. It is likely that the higher bacterial presence in SF is due to lack of manure removal at the feedface.

Key Words: Dairy, Housing, Hygiene

M193 Effect of metabolizable protein and energy intake on amino acid metabolism in growing dairy calves. A. G. Rius*[1], J. Cyriac[1], B. J. Bequette[2], and M. D. Hanigan[1], [1]*Virginia Polytechnic Institute and State University*, *Blacksburg*, [2]*University of Maryland*, *College Park*.

The objective of this study was to examine the relationship between dietary energy and protein on free amino acids (AA) metabolism. Twenty-four newborn Holstein heifer calves where assigned to each of four treatments: 24/17 (24% CP, 17% fat fed at 350 g/d); 32/17 (32% CP, 17% fat fed at 764 g/d); 31/24 (31% CP, 24% fat fed at 782 g/d); and 31/24+ (fed at 1177 g/d) in a complete randomized block design. Diets were fed for 63 d. Blood samples were collected at wks 1, 5, and 9. Heifers were sacrificed at the end of the study and analyzed for body composition. Within 5 min of slaughter liver and muscle samples were collected. Plasma, liver and muscle AA concentrations were determined by gas chromatography-mass spectrometry. Data were analyzed using the GLM procedure of SAS. Calves fed 32/17 had the greatest lean gain as compared to the 24/17 and 31/24 diets and also had a higher N as a percent of EBW (reported elsewhere). There were no significant effects of treatment on total essential amino acid concentrations in muscle (P=0.342) or liver (P=0.721). In muscle, there was a tendency for a significant treatment effect for aspartate (P=0.103) 128.3, 79.9, 99.1, 122.1 µmol/L (SEM =20.1), leucine (P=0.127) 107.8, 131.6, 98.7, 97.6 µmol/L (SEM =14.7), serine (P=0.106) 369.6, 241.2, 269.1, 290.1 µmol/L (SEM =51.9), and methionine (P=0.066) 16.8, 35.0, 28.6, 31.5 (SEM =6.7) µmol/L for the 24/17, 32/17, 31/24 and 31/24+ treatments, respectively. There was a significant treatment effect for liver alanine (P=0.021) 3330.1, 2463.8, 1848.4, 1901,4 µmol/L (SEM=485.2) and serine (P=0.003) 1915.7, 1517.6, 1124.2, 1184.2 µmol/L (SEM =205.2), and a trend for glutamate (P=0.061) 5735.2, 4851.6, 4240.6, 3860.3 µmol/L (SEM =678.8) and histidine (P=0.082) 436.2, 508.8, 344.3, 388.8 (SEM =58.8) for the 24/17, 32/17, 31/24 and 31/24+ treatments, respectively. Overall, the 32/17 treatment supported the greatest methionine concentration in muscle whereas treatment 24/17 supported the greatest concentrations of alanine and serine in liver.

Key Words: Calf, Amino Acid, Energy

Nonruminant Nutrition: General Nonruminant Nutrition

M194 Evaluation of antimicrobial effects on monogastric gut microflora by plant waste products. S. Stella, D. Tedesco*, C. Barbieri, L. Garavaglia, and D. Cattaneo, *University of Milan*, *Italy*.

EU is focusing on effective alternatives to antibiotics in order to reduce the incidence of potential pathogenic bacteria in the gastrointestinal tract of monogastrics. The aim of the present study was to evaluate the effects of plants and their post-processing derivative waste products, recognized as safe for human or animal health (SAFEWASTES, EU project n. 513949), on growth and viability of gut intestinal microbiota in weaning piglets. A total of 28 plant by-products have been tested. Five strains of Escherichia coli, Clostridia and Lactobacilli were isolated from faecal samples of healthy piglets (60–70 days of age), by inoculation of specific culture media. Aliquots of 0.1 mL of bacterial suspension of each selected strain (10^8 CFU/mL) were inoculated onto the surface of agar plates containing the specific culture media. The effects of plant extracts on gut bacteria have been studied using the paper disc agar diffusion (Kirby-Bauer) method. Samples were solubilized into deionized water or ethanol (10 mg/mL) and sterilized by filtration. Sterile paper discs were moistened with extract solution and dried before use. A test paper disc moistened with the extract, a positive control (a disc with Ampicillin or Apramycin) and a negative control (a disc moistened with sterile deionised water or ethanol) were placed under aseptic conditions onto the surface of inoculated culture medium. After incubation, plates were observed in order to find the presence of growth inhibition areas. Four of the 28 tested substances showed an inhibitory effect on E. coli strains, without influence on Clostridia growth. It was not observed any negative effect on commensal microbiota beneficial to the host. None of tested substances showed an inhibitory effect on Lactobacilli growth. On the basis of this preliminary screening, further investigations will be performed in order to confirm the antimicrobial activity of these potential feed additives also in in vivo trials with target species.

Key Words: Plant Waste Products, Gut Microflora, Antimicrobial Effects

M195 Microlocalization of digestion-resistant aromatic lignin and cellulosic compounds in feeds at cellular and subcellular levels with the synchrotron: A novel approach. P. Yu*, *University of Saskatchewan*, *Saskatoon, SK, Canada*.

The objective of this study was to micro-localize the distribution of digestion-resistant aromatic lignin and cellulosic compounds in feeds at cellular and subcellular levels using advanced synchrotron-powered FTIR microspectroscopy (SFTIRM) as a novel approach. The SFTIRM is a newly emerging and non-destructive analytical technique and can reveal molecular chemistry (structural-chemical make-up) of biological samples at highly spatial resolutions (3-10 µm) without destruction of the feed internal structures. The experiment was performed at the National Synchrotron Light Source in Brookhaven National Laboratory (NSLS-BNL, US Department of Energy, New York). The exampled feeds used for this pilot study were corn (cv. Pioneer) and barley (cv. Harrington). The results show that with SFTIRM, the images of the aromatic lignin and cellulosic compounds could be generated to be able to show the distribution and intensity across the feeds tissues. The digestion-resistant aromatic lignin compound only presented in the pericarp region and no lignin has been found in seed coat, aleurone layer and endosperm. The cellulosic compounds presented most in the

pericarp region, less in the seed coat, aleurone layer, and endosperm. The agglomerative hierarchical cluster analysis (CLA) and principal component analysis (PCA) showed the distinct differences of the chemical make-up between the two feeds (corn vs. barley) and between the different structures (pericarp vs. aleurone) within a feed. Even in the same structural regions (such as aleurone layer, and endosperm), the structural make-up were different between the corn and barley. This may explain why digestive behaviors are different between the barley and corn. The implication of this study is that with extremely bright synchrotron light, we can localize and characterize internal feed digestion-resistant compounds in a chemical sense with cellular dimensions.

Key Words: Digestion-Resistant Compounds, Structural Chemistry, Synchrotron

M196 Effects of feeding lactic acid bacteria-based direct-fed microbial complex on growth performance, diarrhea appearance and blood characteristics in pigs. J. S. Yoo*[1], Y. J. Chen[1], J. H. Cho[1], B. C. Park[2], and I. H. Kim[1], [1]*Dankook University*, *Cheonan, Choognam, Korea*, [2]*CJ Feed Inc*, *Incheon, Gyeonggi, Korea*.

This study was conducted to investigate the effects of direct-fed microbial(DFM: *Lactobacillus casei, L. plantarum casei, L. salivarus casei, Saccharomyces cerevisiae*) complex on the growth performance and fecal score in nursery pigs and growing pig. In exp.1, a total of 96 nursery pigs with an average initial BW of 15.00±1.67 kg were used in five weeks experiment trial. There were six pens per treatment with four pigs per pen. Dietary treatments included 1) NC(basal diet; antibiotics free diet), 2) PC(NC diet with 0.1% antibiotics; chlortetracycline 0.05% +neomycin 0.05%), 3) NDFM0.1(NC diet with 0.1% DFM) and 4) NDFM0.2 (NC diet with 0.2% DFM). During the entire experimental period, ADG was increased in PC, NDFM0.1 and NDFM0.2 treatments compared with NC treatment(P<0.05). ADFI was also increased in PC treatment compared with NC treatment(P<0.05). Gain/feed was increased in NDFM0.1 and NDFM0.2 treatments compared with NC treatment(P<0.05). Diarrhea appearance was decreased in PC and NDFM0.2 treatments compared with NC treatment at 5 weeks. In exp. 2, total of 72 growing pigs with an average initial BW of 24.64±2.46 kg were used in 28 days experiment trial. There were six pens per treatment with three pigs per pen. Dietary treatments included 1) NC(basal diet; antibiotics free diet), 2) PC(NC diet with 0.1% antibiotics; chlortetracycline 0.05% +neomycin 0.05%), 3) DFM0.1 (NC diet + 0.1% DFM) and 4) DFM0.3 (NC diet + 0.3% DFM). During the entire experimental period, ADG was increased in NC treatment compared with NDFM0.1 and NDFM0.3 treatments. However, there was no significant treatment effets (P>0.05). Also, there was no significant difference in ADFI among the treatments. Blood characteristics(RBC, WBC and IgG) tended to be improved, however, no significant differences were observed(P>0.05). In conclusion, feeding DFM affected growth performance, diarrhea appearance and blood characteristics in nursery and growing pig.

Key Words: Direct-Fed Microbial(DFM), Growth Performance, Pig

M197 Cupric methionate affect nutrients digestibility and fecal pH and Cu concentration. Y. Huang*[1], Q. Wang[1], Y. Wang[1], J. H. Cho[1], Y. J. Chen[1], J. S. Yoo[1], Y. K. Han[2], and I. H. Kim[1], [1]*Dankook University*, *Cheonan, Choognam, Korea*, [2]*Sungkyunkwan University*, *Suwon, Korea*.

This study was conducted to investigate the effects of organic and inorganic copper on performance in growing pigs. A total of 100 pigs with an average initial weight of 21.46±1.13kg were assigned to five treatments. Dietary treatments include 1) CON (basal diet, 0 ppm Cu), 2) T1 (basal diet with 67 ppm Cu as cupric sulfate, $CuSO_4$), 3) T2 (basal diet with 134 ppm Cu as cupric sulfate, $CuSO_4$), 4) T3 (basal diet with 67 ppm Cu as cupric methionate, CuMet), 5) T4 (basal diet with 134 ppm Cu as cupric methionate, CuMet). During the entire experimental period, ADG, ADFI and GF ratio had no significant differences. Dry matter digestibility of T1, T2, T3 and T4 treatments was improved (P<0.05) compared with the CON. Nitrogen digestibility was improved in T3 treatment compared with control treatment (P<0.05). Compared with T1 treatment, fecal pH value was increased in CON, T3 and T4 treatments (P<0.05). Fecal Cu concentration was significantly lower in CON, T3 and T4 treatments than this of T1 and T2 treatments (P<0.05). Diarrhea appearance was decreased when pigs fed T2, T3 and T4 diets compared with CON. In conclusion, diets supplemented with 67 or 134 ppm Cu as CuMet may be effective for improving nutrient digestibility and fecal pH value in grower pigs and fecal Cu concentration may be decreased by CuMet supplement.

Key Words: Cupric Methionate, Nutrients Digestibility, Growing Pigs

M198 Gain of weight in rabbits of initiation using two commercial diets. M. C. Rubio Robles*, J. M. Beltrán, M. Millán, B. E. Romero, and J. A. Sauceda, *Universidad Autonoma de Sinaloa*, *Culiacan, Sinaloa, Mexico*.

With the objective to determine the gain of weight in rabbits of initiation using Purina commercial food and the district; 12 domestic rabbits were used, of 21 days of age, with a weight average of 276.66±1.3 g.; Two treatments, identified were used like: treatment “A” commercial food the district (Protein 18 %, Fat 2 %, Crude Fiber 14 %, Ash 10 %, And L. N. 44 %, Humidity 12 %) and treatment “B” Purina commercial food (Protein 14,50 %, Fat 2 %, Crude Fiber 18 %, Ashes 10 %, Calcium 1 %, Phosphorus 0,55, And L. N. 43.50 %, Humidity 12 %). Each treatment consist of two repetitions with three rabbits each one; for each repetition; were provided to them food of their respective treatments during 15 d that were the period of the study, it was collected and it weighed the food leftover to know the daily consumption by treatment, also provided new food to them; the weight of the animals was made at the beginning and aim of the study, having itself for the treatment A a weight average of 273.33±2.16 g. and for treatment B 280±1.26 g. Being a final weight for the treatment A from 398.33±1.63g. and 395±2.09 g. for treatment B. In all the period, the gain of weight average by animal, went for the treatment A of 125 g. whereas Treatment B gain in average 115 g. with which it is appraised that the treatment A had in average by animal 10 g. (8%) but gain of weight that the B. with respect to the food consumption the treatment A was of 730 g. and 760g for treatment B, being a nutritional conversion from 5,84 for the treatment A and 6,61 for treatment B. concluding that the animals that fed with the treatment A: commercial food the district had one better answer with a 8% but gain of weight, a food consumption 3,95% less and 11,65 % better nutritional conversion with respect to the Purina commercial food.

Key Words: Rabbit, Weight, Commercial Food

M199 Effects of Bio-Mos® on growth and survival of channel catfish challenged with *Edwardsiella ictaluri*. B. C. Peterson*[1], S. Quiniou[1], B. B. Manning[2], and T. C. Bramble[3], [1]*USDA/ARS*, *Stoneville, MS*, [2]*MSU*, *Stoneville, MS*, [3]*Alltech Biotechnology*, *Nicholasville, KY*.

A major problem in the catfish farming industry has been high disease loss to enteric septicemia of catfish (ESC), caused by the bacterium *Edwardsiella ictaluri* (*E. ictaluri*). Methods to control this disease include antibiotic therapy, vaccinations, and management strategies such as taking the fish off feed. Alternative methods such as feeding yeast-derived mannans in the form of Bio-Mos® may prove beneficial in improving growth performance and immune function. Research was conducted to examine the effects of Bio-Mos® on growth and immune function in channel catfish. One hundred fish (45.8 ± 1.2 g) were randomly assigned to two treatments with five replicates each: 1.) Control (36% CP catfish diet) and 2.) Bio-Mos® (36% CP catfish diet with Bio-Mos® supplemented at 2 g/kg). The fish were fed for 6 wks and then challenged with *E. ictaluri*. Mortality was recorded daily for 3 wks. Levels of lysozyme activity were determined pre- and post-challenge. At the end of the 6 wk growth study, weight gain and FE was similar between treatments. Survival was higher ($P < 0.05$) in fish fed Bio-Mos® compared to Controls (90 ± 7.3% vs 55 ± 6.4%). Plasma levels of lysozyme activity were similar ($P > 0.10$) between treatments. The results of this study suggest that Bio-Mos® can be supplemented into catfish diets without negatively affecting growth or FE. The results also show that Bio-Mos® improves resistance to *E. ictaluri* without significantly altering lysozyme activity. Supplementing Bio-Mos® into diets may provide another strategy to control ESC in channel catfish.

Key Words: Bio-Mos®, Disease, Catfish

M200 The effect of plant tannins and yucca extracts on in vitro ruminal fermentation and methane gas production. B. R. Min*[1], W. E. Pinchak[1], R. C. Anderson[2], and R. Puchala[3], [1]*Texas Agricultural Research Center*, *Vernon, TX*, [2]*USDA/ARS*, *College Station, TX*, [3]*E (Kida) dela garza American Institute for Goat Research*, *Langston, OK*.

The overall objective was to quantify in vitro, the effect sources of tannin and yucca extract at 2 dose levels on rate of gas production, ruminal fermentation and protease enzyme activity. Pine bark was used as a non-extracted plant tannin source for negative control. In vitro gas and methane production were measured from 0 to 6 h rumen incubation periods. In vitro rate of gas and potential gas production were linearly decreased ($P < 0.01$) in a dose dependent manner for quebracho (QT), mimosa (MT), chestnut tannins (CTT), and pine bark (PB) addition. In the presence of QT ($P < 0.03$), MT ($P < 0.02$), CTT ($P < 0.02$), yucca ($P = 0.06$), and PB ($P = 0.11$), methane production was linearly decreased. Cumulative hourly total in vitro ruminal gas production was similar between control, yucca and PB after 6 h rumen fermentation at 5 mg extracts/ml, but cumulative ruminal gas production was lower for QT ($P < 0.01$), MT ($P < 0.001$), and CCT ($P < 0.001$) after 3 - h fermentation from control treatment. Total average VFA concentration was not affected by CCT and yucca extracts treatments, but total VFA was linearly decreased for QT ($P < 0.04$), MT ($P < 0.01$) and PB ($P < 0.01$) tannins treatments. Acetate and propionate (A/P ratio) molar ratios for QT ($P <0 .01$), MT ($P < 0.01$), yucca ($P = 0.11$), and PB ($P = 0.001$) decreased linearly in a dose dependent manner. Hydrolysis of azocasein, used to estimate ruminal protease enzyme activity, was decreased linearly for all tannins and yucca extracts. It is concluded that addition of commercial tannins and yucca extracts changed in vitro rumen fermentations and VFA profiles. Addition of tannins and yucca extracts, except chestnut tannins, decreased A/P ratios, indicated that plant tannins and yucca extracts may be nutritionally benefit in terms of increased VFA efficiency with either dose level of those plant extracts.

Key Words: Methane Gas, Rumen Fermentation, Tannins

M201 Evaluation of the efficacy of a commercial purified phylosilicate to reduce the estrogenic effects of zearalenone in gilts. B. Malone[1], C. Bond[1], C. Maue[1], Z. Scheitegger[1], and D. Zaviezo*[2], [1]*Trilogy Analytical Laboratory*, *Washington, MO*, [2]*Special Nutrients*, *Miami, FL*.

An experiment was conducted to study the efficacy of a very low inclusion of commercial purified phylosilicate (Myco-Ad A-Z) in preventing the deleterious estrogenic effects of zearalenone (ZEA) in prepubertal gilts. Eighteen 20-d old recently weaned Yorkshire Cross gilts individually housed were randomly distributed into 3 dietary treatments with 6 replications each. After a 4-d pretrial adaptation period, pigs were fed a commercial basal diet containing or exceeding NRC recommended nutrients levels for 30 d. The feed was experimentally contaminated with crystalline ZEA, determined to be over 99% pure. Treatments were: (1) control basal diet; (2) control + 750 ppb ZEA; and (3) control + 750 ppb ZEA + 1 kg/mt Myco-Ad A-Z. At the end of the experiment all pigs were sacrificed and the internal reproductive organs weighed. Results indicated no significant differences in body weight (wt) gain, feed intake and feed conversion ratio among treatments. Gilts fed 750 ppb ZEA contaminated diet showed significant heavier ovary + bursa wt (40%), uterus wt (93%), cervix wt (260%) and total reproductive organs wt (98%) than gilts fed the control diet. The addition of Myco-Ad A-Z to the contaminated diet resulted in gilts with a statistically significant reduction in ovary + bursa wt (12%), uterus wt (25%), cervix wt (32%) and total reproductive organs wt (24%) than those fed 750 ppb ZEA. Even though the addition of 1 kg/mt of Myco-Ad A-Z to a gilt diet contaminated with 2 to 3 times the ZEA level producing problems in the field did reduce the abnormal growth of the reproductive organs; they were still heavier than those from gilts fed the control diet. These results indicate that Myco-Ad A-Z at 1 kg/mt was effective in reducing the estrogenic effects of ZEA in prepubertal gilts.

Key Words: Myco-Ad A-Z, Zearalenone, Gilts

M202 Response of market turkey toms to dietary protein and threonine levels in diets containing corn distillers dried grains. S. L. Noll* and J. Brannon, *University of Minnesota*, *St. Paul*.

The response of market turkey toms to diet threonine level was examined during 8 to 19 wks of age. Diets were formulated to contain 90, 94, 100, and 106% NRC digestible thr from intact protein. In addition, supplemental thr was used to reach 100 or 106% NRC thr. Diets were composed primarily of corn, soybean meal, poultry by-product meal (PBM, 10%) and corn distillers dried grains with solubles (DDGS, 20%). Large White male turkey poults (Nicholas strain) were randomly assigned to pens (10/pen) at 8 wks of age. The treatments were (T): 1. Corn soy control, 100% NRC thr; 2. PBM-DDGS 106% NRC thr; 3. As T2, plus 6% NRC thr; 4. As T2, 100% NRC thr; 5. As T4, plus 6% NRC thr; 6. As T4, plus 12% NRC thr; 7. As T2, 94% NRC thr; 8. As T7 plus 6% NRC thr; 9. As T7 plus 12% NRC thr; 10. As T2, 90% NRC thr; 11. As T10 plus 10% NRC thr. All diets were supplemented as needed with lys and met to meet the specific NRC recommendations for these amino acids. The ratio of calcium: inorganic phosphorus was maintained at 2:1. Each diet was fed to 8 replicate pens. The experimental design was a completely randomized block design. Dietary treatment affected body weight at all ages (P<.0001). BW at 19 wks of age was similar for T 1, 2, 3 and 4. Decreasing diet NRC thr to 94 and 90% significantly decreased BW while supplementation with thr improved body weight but not to the level of the control at 100% NRC. Increased average daily gain response to supplemental thr (6% NRC thr) was observed for 100, 94, and 90% NRC thr treatment groups during 8-11 and 11-14 wks of age; and, only in the 90% NRC thr treatment during 14-17 and 17-19 wks of age. Improved feed efficiency in response to supplemental thr (6% NRC thr) was observed for the 94% NRC treatment during 8-11 wks; and, for the 90% NRC thr group during 8-11 and 17-19 wks of age. In diets containing a large amount of alternative protein (10% PBM and 20% DDGS), a gain response to supplemental thr was observed when diet thr from intact protein was less than 106% NRC during 8-11 wks, less than 100 % NRC during 11-14 wks, and less than 94% NRC during 14-19 wks of age.

Key Words: Turkey, Distillers Grains with Solubles, Threonine

M203 Influence of feed form and fiber inclusion in the diet on performance of broilers from one to twenty one days of age. E. Jiménez-Moreno[1], J. M. González-Alvarado[1,2], A. P. Bonilla[1], R. Lázaro[1], and G. G. Mateos*[1], [1]*Universidad Politécnica de Madrid*, *Spain*, [2]*Universidad Autónoma de Tlaxcala*, *México*.

We studied the effects of feed form and the inclusion of fiber in the diet on productive performance of broilers from 1 to 21 d of age. There were twelve treatments arranged factorially with two feed forms (mash and pelleted) and six diets consisting in the combination of three insoluble fiber sources (OH; oat hulls, RH; rice hulls, and SFH; sunflower hulls) and two levels of fiber source inclusion (2.5 vs. 5%). In addition, a control diet without additional fiber was formulated and offered either in mash or pellet form. The diameter of the pellets was 2–mm. The control diet was based on rice, soy protein concentrate, fish meal, and fat, and had 3,200 kcal AME_n/kg, 1.4% total lysine, and 1.6% crude fiber. The fiber source was included in the experimental diets at expenses (wt/wt) of the whole diet. Each treatment was replicated six times (a cage with 12 chicks). Body weight (BW) and feed consumption (ADFI) were recorded per replicate at 0, 4, 8, 14, and 21 d of age. No interactions between main effects were observed. For the entire experiment, broilers fed pellets had better BW gain, higher ADFI, and lower feed conversion ratio (FCR) than broilers fed mash ($P \leq 0.001$). Fiber inclusion tended to improve BW gain ($P \leq 0.1$) and improved FCR ($P \leq 0.05$) but no differences were observed between diets containing 2.5 or 5% fiber source for any trait studied. From 0 to 4 d of age, broilers fed SFH had better FCR than broilers fed OH or RH (0.844 vs. 0.870 and 0.876; $P \leq 0.05$) but the effect disappeared with age. We conclude that pelleting improves productive performance of broilers from 1 to 21 d of age. Also, the inclusion of fiber source at levels of up to 5% (from 1.61% crude fiber in the control diet to 4.24% crude fiber in the 5% RH containing diet) improves productive performance in chicks fed low–fiber diets. Therefore, chicks might have a requirement for a minimum amount of fiber in the diet.

Key Words: Pellet, Fiber Sources, Broiler Performance

M204 Nutritional value of corn distiller dried grains with solubles (DDGs): Influence of solubles addition. S. L. Noll*[1], J. Brannon[1], and C. Parsons[2], [1]*University of Minnesota*, *St. Paul*, [2]*University of Illinois*, *Champaign*.

Batches of corn distiller dried grains were produced with varying levels of solubles (syrup) added back to the wet grains (mash) in cooperation with a Minnesota ethanol plant. The batches produced contained syrup added at approximately 0, 30, 60, and 100% of the maximum possible addition of syrup to mash. Actual rates of syrup addition were 0, 12, 25, and 42 gal/minute. The different combinations of mash and syrup were dried at the plant with a lag of 60 minutes in between the changes for the different rates of syrup addition. Samples of each lot of material were taken and were chemically analyzed. Digestible amino acid content was determined with cecectomized roosters. True metabolizable energy (TMEn) was determined in intact young growing turkeys. Regression analyses and correlation coefficients (Pearson) were conducted to determine the extent of the relationship between the level of solubles added and the resulting nutrient content. Particle size was greatly affected with larger and more variable particle size with the highest level of solubles addition. The larger particles ("syrup balls") were readily apparent in the 100% batch and are of concern for product quality for poultry feeds. Content of fat and ash increased with solubles addition. Fat content increased from 8% in the dried grains to 10.5% (as fed basis) where 100% of the solubles were added back. The TMEn content also increased with solubles addition from 2712 kcal/kg for the dried grains to 3743 kcal/kg where 100% of the solubles were added back. Mineral content, especially for magnesium, sodium, phosphorus, potassium, chloride, and sulfur increased as the level of solubles addition increased. Protein and amino acid content showed very little change in the various products. True amino acid digestibility coefficients of the essential amino acids tended to be negatively correlated with solubles addition. The results indicate that solubles addition has the largest effect on particle size, color, and; content of fat and minerals.

Key Words: Distillers Grains, Solubles, Energy

M205 Metabolizable energy value of crude glycerin for laying hens. K. Bregendahl*[1], P. Lammers[1], B. Kerr[2], M. Honeyman[1], K. Stalder[1], T. Weber[1], W. Dozier, III[3], K. Dion[1], M. Neal[1], and S. Mottet[1], [1]*Iowa State University*, *Ames*, [2]*USDA/ARS*, *Ames, IA*, [3]*USDA/ARS*, *Mississippi State, MS*.

An experiment with laying hens was conducted to determine the AMEn value of crude glycerin, a coproduct of biodiesel production. Crude glycerin (86.95% glycerol, 9.22% water, 0.03% methanol, 1.26% Na, 3625 kcal/kg gross energy) was obtained from AG Processing Inc., Sergeant Bluff, IA. A total of 48 40-wk-old laying hens (Hy-Line W-36) were placed in metabolic cages (2 hens/cage) in a light-controlled (16:8 L:D) room and given free access to the experimental diets. A basal diet (19% CP; 2922 kcal/kg AMEn) was formulated using corn, soybean meal, and meat and bone meal with 15% glucose and 1% Celite (to increase the content of acid-insoluble ash used as an indigestible marker). The 4 treatment diets were created by substituting 0, 5, 10, or 15% crude glycerin for glucose (3640 kcal/kg AMEn). After 7 d of dietary adaptation, excreta was collected twice daily for 3 d, freeze-dried, and analyzed for contents of DM, Kjeldahl N, acid-insoluble ash, and gross energy. Egg production was recorded daily, and eggs collected on Day 7 and 8 of the experiment were weighed for calculation of egg mass (egg production × egg weight). Feed consumption was measured over the entire 13-d-long experiment. Egg-production data were analyzed using ANOVA with 4 treatments and 6 replications in a completely randomized experimental design. The AMEn value of the crude glycerin was estimated as the slope of the linear relationship between the inclusion rate of dietary crude glycerin and the glucose-corrected AMEn value of the experimental diets. There were no treatment effects ($P > 0.05$) on the hens' egg-production rate (93.0%), egg weight (56.1 g), egg mass (52.2 g/d), or feed consumption (104 g/d). Linear regression analysis ($P < 0.001$, $r^2 = 0.92$, $n = 24$) showed that the AMEn value of the crude glycerin used in this study was 3805 ± 238 kcal/kg (mean ± SE; as-is basis) for laying hens. The results of this study show that the energy in crude glycerin is utilized with high efficiency by laying hens.

Key Words: Crude Glycerin, Metabolizable Energy, Laying Hens

M206 Nutrient digestibility of high protein corn distillers dried grains with solubles, dehydrated corn germ and bran. A. Batal*, *University of Georgia*, *Athens*.

Sectors of the ethanol industry are starting to use a new bio-refining production technology which separates the corn into three fractions: fiber, germ and endosperm, prior to ethanol production. These fractions are then converted into new co-products, high protein distillers dried grains with solubles (HP-DDGS), dehydrated corn germ meal, and bran cake. Studies were conducted to determine the nutritional parameters of these new co-products. A chick experiment was conducted to determine the phosphorus (P) bioavailability based on tibia ash. In addition, conventional and cecectomzied precision-fed rooster assays were conducted to determine TME_n and amino acid digestibility. For the chick assay, a P-deficient corn-soybean meal diet containing 0.13% non-phytate P was supplemented with 0, 0.05, 0.10, and 0.15% from KH_2PO_4 or 7 and 14% DDGS, HP-DDGS, and corn germ. Cobb 500 chicks were fed the experimental diets to 18 d of age and bioavailability of P was estimated using the slope-ratio method where tibia ash was repressed on P intake. The total P content and P bioavailability of the DDGS, HP-DDGS, and corn germ were 0.77 and 60, 0.35 and 47, and 1.18 and 31%, respectively. The average protein, fiber, and fat % for DDGS was 27, 7, and 10, for HP-DDGS 44, 7, and 3, for corn germ 15.5, 4.5, and 17, and for bran 11.6, 4.5, 7.8. The average TME_n was 2,829, 2,700, 2,965, and 2,912 kcal/kg (as-fed basis) for the DDGS, HP-DDGS, corn germ, and bran, respectively. Bran had a higher TME_n value than expected, which is likely due to the high fat content. Total concentration and percent availability, of lysine for the DDGS, HP-DDGS, corn germ, and bran was 0.79 (81), 1.03 (72), 0.83 (80) and 0.43% (68%), respectively. The total lysine as a % of CP was 3% for the conventional DDGS and only 2% for the HP-DDGS, however these products had a similar TME_n. New bio-refining techniques result in co-products that have unique nutritional qualities compared to conventional DDGS. Thus, confirmatory analyses should be conducted prior to utilizing these new co-products of ethanol production.

Key Words: Distillers Dried Grains with Solubles, Corn Germ, Amino Acid Digestibility

M207 Effects of sorghum variety on growth and subsequent egg production in layers reared in West Africa. S. Issa*[1,2], J. D. Hancock[1], M. R. Tuinstra[1], I. Kapran[2], and S. Kaka[2], [1]*Kansas State University*, *Manhattan*, [2]*National Institute for Agricultural Research in Niger*, *Niamey, Niger*.

A total of 450 1-d-old layer chicks (Harco line with an initial body weight of 29 g) were used in an 18-month experiment to determine the effects of sorghum variety on growth and egg production. There were 50 chicks/pen and three pens/treatment with feed and water consumed on an ad-libitum basis. The control diet was corn based with fishmeal and peanut cake used as the primary protein supplements. The control was formulated to exceed recommendations for all nutrient concentrations as suggested in the 1994 NRC for poultry. Sorghum was used to replace the corn on a wt/wt basis so that treatments were: 1) corn (imported from Nigeria)-based control; 2) a locally adapted landrace variety of sorghum (Mota Galmi) with red seed, purple plant, and 0.3 mg catechin equivalents/100 mg of grain DM; and 3) an agronomically improved variety of sorghum (IRAT 204) with white seed, tan plant, and no detectable tannins. For d 0 to 126, there were no differences ($P > 0.12$) in average daily gain (ADG) and gain to feed ratio (G:F) among birds fed the corn and sorghum treatments. However, the numerical advantage in ADG for birds fed the agronomically improved sorghum resulted in a 79 g advantage ($P < 0.001$) in body weight at the beginning of the laying period compared to birds fed the locally adapted sorghum. For the laying period, birds fed the sorghum grains took fewer days to come into production ($P < 0.007$), ate more feed ($P < 0.02$), and produced more eggs ($P < 0.001$) than birds fed the corn-based diet. There were no differences in average egg weight and egg:feed ratio among birds fed corn and the sorghums. Means for corn, locally adapted sorghum, and improved sorghum were 1,855, 1,840, and 1,919 g body weight at 126 days, 141, 135, and 133 d to reach 20% production, and 47, 56, and 55% production for the entire laying period. In conclusion, sorghum grain was equal (if not superior) to corn as a feedstuff in diets for layers reared in West Africa.

Key Words: Sorghum, Corn, Layer

M208 Dietary inclusion of a dairy processing plant by-product on performance and processing yields of broilers. H. L. Santiago*, L. J. Pérez, J. A. Orama, and A. A. Rodríguez, *University of Puerto Rico*, *Mayagüez, Puerto Rico*.

Dairy processing wastes resulting from the manufacture of Latin white cheese have nutrient profiles similar to grains used in poultry diets and can become potential feed sources at reasonable prices. The objective of this study was to evaluate the dietary inclusion of a dairy industry by-product (DIBP) on growth performance and processing yields of broilers. The dried DIBP incorporated into diets had a 50.6% crude protein and 1.9 % fat content. A total of 540 d-old chicks were randomized in three treatments with six replicate pens of 30 birds each. Treatments consisted of diets containing 0 (control), 3, and 6% DIBP. Feed and birds were weighed weekly up to 42 d of age to determine body weight (BW), feed intake (FI), and feed conversion (FC). At market age (43 d), a total of 180 birds were processed to evaluate carcass composition and to determine processing yields. The dietary inclusion of DIBP had no effect on growth performance of broilers. At all ages, broilers fed a 3 and 6% of DIBP had similar BW, FI, and FC than that of controls. Although, no significant differences among dietary treatments were observed for FC, birds fed diets containing 6% DIBP tended to have better FC when compared to birds fed control and 3% DIBP diets. Mortality and the percentage of culled birds were similar for all dietary treatments. No differences among treatments were observed in yields of carcass, abdominal fat, mayor cuts, and breast meat. Fat pad yield declined from 1.14 to 0.97 % as the percentage of DIBP inclusion in the diet increased. The results of this study indicate that the DIBP evaluated could be a valuable feed ingredient to supply part of the dietary protein and metabolizable energy requirements of broilers. The results showed that DIBP could be used in broiler diets up to 6% without compromising growth performance, health, and processing yields.

Key Words: Broilers, Growth, Dairy By-Product

M209 The researches for the functional components in fish meal for broiler chickens. K. Nakagawa*[1], T. Akazawa[2], M. Tamura[2], and H. Sato[1], [1]*Ajinomoto Co., Inc.*, *Tokyo, Japan*, [2]*Itochu Feed Mills Co., Ltd.*, *Tochigi, Japan*.

In our previous studies, we found that the broiler chickens grew faster when birds were fed a diet containing fish meal than when fed all-vegetable diet or a diet containing chicken meal. However, there was no effect of sole supplementation of the specific components in fish meal (ex. fish oil, creatine, glycine or taurine). Two broiler trials were conducted to identify what components in fish meal have key roles for growth. In the initial trial, 240 male Cobb broiler chicks of 0-d-old were allocated to one of four treatments with six replicates of 10 birds each. The experimental diets were all-vegetable diet (VEG as control, a diet containing 5% fish meal (FM), 5% soluble fraction (SF) or 5% insoluble fraction (IF) of fish meal, respectively. Both SF and IF were prepared by separating the slurry of fish meal into the solid and liquid parts, drying up the solid as IF, and freeze-drying the liquid as SF. Chicks were fed each experimental diet for two weeks, with individual body weight and feed intake per replicate measured on day 7 and 14. On day 14, body weight ($P<0.01$) and feed intake ($P<0.01$) were significantly improved by feeding FM, SF and IF comparing with feeding VEG. In the subsequent trial, we focused on the effect of the soluble fraction and conducted an experiment with the similar procedures with the initial one. The experimental diets were VEG, a diet containing 4% SF, 1.7% low MW fraction of SF (LMW) or 2.3% high MW fraction of SF (HMW). The inclusion of LMW and HMW in the diets was determined based on their proportion (weight %) in the whole SF. LMW and HMW were prepared from SF by using a membrane filter for 1,000 MW. On day 14, body weight ($P<0.01$), feed intake ($P<0.01$) and feed conversion ratio ($P<0.10$) were significantly improved by feeding SF and HMW comparing with feeding VEG, and not improved by feeding LMW. These results suggest that several components in fish meal have beneficial functions, and they are included in the insoluble fraction and the soluble fraction of high MW.

Key Words: Fish Meal, Fraction, Broiler Chicken

M210 Evaluation of NutriDense® corn compared to conventional corn fed to laying hens. P. Utterback*[1], E. Kim[1], C. Jacobs[1], C. Utterback[1], C. Parsons[1], J. Snow[2], and J. Weigel[2], [1]*University of Illinois*, *Urbana*, [2]*BASF Plant Science*, *Research Triangle Park, NC*.

A 12-week experiment was conducted using 360 Hy-Line W-36 hens (24 wk of age) to compare NutriDense® (ND) corn, supplied by BASF Plant Science, to conventional (CONV) corn when used in laying hen diets. Treatment 1 utilized conventional corn formulated to meet NRC (1994) requirements for layers, and the diet was formulated to contain 17% crude protein and 2900 kcal of MEn. Treatment 2 also used conventional corn, but the diet was formulated to contain lower nutrient levels to reduce feed costs. The Treatment 2 diet was formulated to contain 15% crude protein and 2800 kcal of MEn. Treatments 3 & 4 were the same as 1 & 2, respectively, but with ND corn added in place of CONV corn. The final treatment was a least-cost formulated diet containing the same nutrient levels as Treatment 1 but using ND corn instead of CONV corn. The latter treatment was included to compare the economic value of ND corn compared to the CONV corn. Diets were fed for 12 weeks, and data were summarized at two-week intervals. There were no differences among any of the treatments at any time period for body weight, hen-day egg production, egg weight, egg mass, egg specific gravity, or mortality. Feed consumption showed statistical differences among treatments ($P< 0.05$) at Week 6, 10, 12, and cumulatively, with feed intake being highest for Treatment 2 and lowest for Treatment 3. There were also significant differences in feed efficiency (egg mass divided by feed intake) among treatments at Weeks 8, 10, 12, and cumulatively due to Treatment 2 being significantly ($P<0.05$) lower than all other treatments. The results of this study indicate that the egg production performance of laying hens fed ND corn is equal to or superior to that of hens fed CONV corn and that feeding ND corn may reduce feed costs.

Key Words: Laying Hens, NutriDense® Corn, Conventional Corn

M211 Comparison of broiler performance and carcass parameters when fed diets containing combined trait insect-protected and glyphosate-tolerant corn (MON 89034 × NK603), control, or conventional reference corn. M. L. Taylor*[1], G. F. Hartnell[1], D. M. Lucas[1], M. A. Nemeth[1], and S. W. Davis[2], [1]*Monsanto Company*, *Creve Coeur, MO*, [2]*Colorado Quality Research*, *Wellington, CO*.

A 42-d floor pen study was conducted to compare broiler (Ross × Ross 308) performance and carcass measurements when fed diets containing lepidopteran protected corn combined with glyphosate tolerant corn (MON 89034 × NK603) with those of broiler fed diets containing corn grain from the conventional control and 6 conventional corn hybrids. MON 89034 produces the Cry1A.105 and Cry2Ab2 insecticidal

proteins that protect corn plants from feeding damage caused by European corn borer (Ostrinia nubilalis) and other lepidopteran insect pests. The combination of the Cry2Ab2 and Cry1A.105 insecticidal proteins in a single plant provides outstanding insect control and offers an effective insect-resistance management tool. NK603 produces the 5-enolpyruvylshikimate-3-phosphate synthase protein from Agrobacterium sp. strain CP4 (CP4 EPSPS), which confers tolerance to glyphosate, the active ingredient in Roundup$|reg; agricultural herbicides. MON 89034 × NK603 was produced by traditional breeding of plants that express the individual traits. Broilers were fed starter diets (approximately 57% wt/wt corn grain) from d 0 to d 21 and grower/finisher diets (approximately 59% wt/wt corn grain) from d 21 to d 42. The study utilized a randomized complete block design with 8 dietary treatments assigned randomly within 5 blocks of 16 pens each (8 male and 8 female) with 10 birds per pen. There were 10 pens per treatment group (5 male and 5 female). Weight at d 0 and d 42, feed intake, and feed conversion, and all measured carcass and meat quality parameters were not different (P > 0.05) for birds fed MON 89034 × NK603 and control corn diets. In addition, comparisons of the MON 89034 × NK603 diet to the population of the control and 6 reference corn diets showed no difference (P > 0.05) in any performance, carcass, or meat quality parameter measured. In conclusion, the diets containing MON 89034 × NK603 were nutritionally equivalent to diets containing the control or conventional reference corn grain when fed to broilers.

Key Words: Broiler Performance, Carcass Yield, Genetically Modified Corn

M212 Comparison of broiler performance and carcass parameters when fed diets containing soybean meal produced from glyphosate-tolerant (MON 89788), control or conventional reference soybeans. M. L. Taylor*[1], G. F. Hartnell[1], D. M. Lucas[1], M. A. Nemeth[1], and S. W. Davis[2], [1]*Monsanto Company*, *Creve Coeur, MO*, [2]*Colorado Quality Research*, *Wellington, CO*.

A 42-d floor pen study was conducted to compare broiler (Ross × Ross 308) performance and carcass measurements when fed diets containing meal produced from glyphosate-tolerant soybeans (MON 89788) with those of broilers fed diets containing meal produced from control soybean (A3244) that has similar genetic background to MON 89788. Soybean meal produced from 6 conventional soybean varieties were included in the study to provide comparison measurements for broilers fed meal derived from conventional soybeans. MON 89788 produces the 5-enolpyruvylshikimate-3-phosphate synthase protein from Agrobacterium sp. strain CP4 (cp4 epsps), which confers tolerance to glyphosate, the active ingredient in Roundup® agricultural herbicides. Broilers were fed starter diets (approximately 33% wt/wt dehulled soybean meal) from d 0 to d 21 and grower/finisher diets (approximately 30% wt/wt dehulled soybean meal) from d 21 to d 42. The study utilized a randomized complete block design with 8 dietary treatments assigned randomly within 5 blocks of 16 pens each (8 male and 8 female) with 10 birds per pen. There were 10 pens per treatment group (5 male and 5 female). No treatment differences (P > 0.05) were detected among dietary treatments for feed intake, weight gain, feed conversion, adjusted feed conversion, or any measured carcass and meat quality parameters. Comparison of all performance, carcass, and meat quality parameters measured showed no differences (P > 0.05) between birds fed the MON 89788 soybean meal diet and the population of birds fed the control and 6 conventional reference soybean meal diets. It is concluded that the diets containing soybean meal produced from MON 89788 were nutritionally equivalent to diets containing soybean meal produced from the control and conventional reference soybean varieties when fed to broilers.

Key Words: Broiler Performance, Carcass Yield, Genetically Modified Soybean

M213 Broiler chicken performance as affected by diets containing cashew nut meal submitted to different storage conditions. I. R. V. Lopes[1], M. F. F. Fuentes*[1], E. R. Freitas[1], J. R. Lima[2], R. B. Silva[1], R. C. Lima[1], and R. M. Bezerra[1], [1]*Universidade Federal do Ceará*, *Fortaleza, CE, Brazil*, [2]*Embrapa Agroindústria Tropical*, *Fortaleza, CE, Brazil*.

Cashew nut meal (CNM) is an abundant sub product from the cashew nut processing industry in Northeast Brazil and it contains about 47.8% ether extract and 22% crude protein. This experiment was conducted to evaluate the performance of broiler chickens fed diets containing CNM which had been stored with or without addition of butylated hydroxytoluene (BHT) as an antioxidant additive. A 400kg batch of freshly produced CNM was divided into five portions. One portion was stored without BHT and the others were added of 500 ppm BHT at 0, 7, 14 and 21 days of storage. Total storage time was 35 days. Weekly samplings of CNM were taken for peroxide index (PI) determination. At the end of the storing period five isoproteic and isocaloric diets were formulated as to contain 15% CNM from each of the five different storage conditions described above. A feeding trial was then carried out with 480 day old chicks males Ross x Ross. Birds were randomly distributed among the five treatments with eight repetitions of twelve birds each. The variables studied were weight gain, feed intake and feed conversion. PI values in stored CNM, with or without BHT, increased with storage time. However, diets containing CNM with or without BHT and stored for 35 days did not affect (P≥0.05) the variables studied. CNM stored for 35 days without BHT can be used in broiler diets with no effect on bird performance.

Key Words: Weight Gain, Feed Conversion, Peroxide Index

M214 Broiler performance and carcass characteristics when fed diets containing Lysine maize (LY038 or LY038 × MON 810), control or conventional reference maize. D. M. Lucas*[1], M. L. Taylor[1], G. F. Hartnell[1], M. A. Nemeth[1], K. C. Glenn[1], and S. W. Davis[2], [1]*Monsanto Company*, *St. Louis, MO*, [2]*Colorado Quality Research*, *Wellington, CO*.

Lysine maize, LY038, was developed through the application of modern biotechnology to accumulate free lysine (Lys) in the germ portion of maize grain and provide an alternative to direct addition of supplemental Lys to poultry diets. Maize LY038 × MON 810 was produced by conventional breeding of LY038 with MON 810, which provides the maize plant protection against feeding damage from the European corn borer. A 42–d broiler feeding study (10 pens of 10 male Cobb × Cobb 500 broilers/treatment) was conducted to compare the feeding value of grain from LY038 or LY038 × MON 810 to that of a conventional control (similar genetic background to the test maize) and 5 conventional maize hybrids. LY038 and LY038 × MON 810 diets, and control and conventional reference maize diets supplemented with L–Lys HCl were formulated to a Lys level below that required for

optimal bird performance; whereas, all other essential amino acids were present at levels, relative to Lys, above those required for optimal bird performance [1.05% and 0.90% total Lys (as-fed) for d 0 to 21 and d 21 to 42, respectively]. Total Lys level in control and reference maize based diets without supplemental L–Lys HCl were formulated to be 0.079% lower than supplemented diets. Weight gain, feed efficiency, and carcass yield and composition of broilers fed diets containing LY038 or LY038 × MON 810 were not different ($P \geq 0.05$) from that of broilers fed L–Lys HCl supplemented diets and were superior ($P \leq 0.05$) to that of broilers fed conventional maize diets without supplemental L–Lys HCl. Both broiler performance and carcass data demonstrate that the bioefficacy of the incremental Lys in LY038 or LY038 × MON 810 grain was not different from that of Lys in conventional maize diets supplemented with L–Lys HCl. LY038 and LY038 × MON 810 can be considered as wholesome as and more nutritious than conventional maize due to its higher than average Lys content.

Key Words: Broiler Performance, Lysine, Maize

M215 Effects of selection for mold resistance on nutritional value of sorghum grain in broiler chicks. C. R. Monge*[1], J. D. Hancock[1], C. Feoli[1], W. L. Rooney[2], S. R. Bean[1,3], and S. Beyer[1], [1]*Kansas State University*, *Manhattan*, [2]*Texas A&M University*, *College Station*, [3]*USDA/ARS*, *Manhattan*.

A total of 264 broiler chicks (Cobb x Cobb, 14 d of age, and average initial body weight of 403 g) was used in a 7-d metabolism experiment to determine the effects of selection for mold resistance on nutrient utilization. A reference diet with 50% cornstarch was formulated to meet or exceed all nutrient concentrations recommended in the 1994 NRC for poultry. Sorghum grain was then substituted for cornstarch in the reference diet. Treatments were sorghums selected from a plant-breeding program that were susceptible and resistant to mold and weathering. These sorghums were grown at four locations in Texas (Corpus Christi, Beeville, College Station, and Halfway) and one location in Kansas (Manhattan). The chicks were adjusted to treatment for 4 d followed by 3 d collection of excreta. The excreta were dried, ground, and analyzed for DM, N, and GE with Cr2O3 used as an indigestible marker. Analysis of variance suggested there were no interactions ($P > 0.66$) among location and sorghum type for average daily gain (ADG), gain to feed ratio (G:F), and retention of DM and GE. Also, there were no effects of location or sorghum type on ADG and G:F ($P > 0.37$). However, there were trends ($P < 0.06$) for location effects on retention of DM and N and these trends were in agreement with the greater retention of GE ($P < 0.02$) for chicks fed sorghums produced in Beeville vs the other locations. There was a trend ($P < 0.06$) for greater retention of DM among chicks fed the susceptible vs the resistant sorghum, but retention of N and GE were not affected by sorghum type ($P > 0.3$). Means for the susceptible and resistant sorghums were 44 and 46 g/d for ADG, 707 and 710 g/kg for G:F, 72 and 70% for retention of DM, 47 and 49% for retention of N, and 77 and 76% for retention of GE, respectively. In conclusion, selection for mold resistance had minimal and inconsistent effects on the nutritional value of sorghum grain for broiler chicks.

Key Words: Sorghum, Mold Resistance, Poultry

M216 Influence of fish meal processing on performance of broilers from 1 to 28 days of age. A. P. Bonilla, A. de Coca-Sinova, E. Jiménez-Moreno, R. Lázaro, and G. G. Mateos*, *Universidad Politécnica de Madrid*, *Spain*.

Bacterial contamination and particularly Salmonella spp. contamination limits the use of fish meal (FM) in prestarter diets for broilers. In consequence, FM processing plants apply severe heat conditions (100° C for 120 min) during rendering to reduce bacterial load. However, an increase in time and temperature conditions during processing might reduce amino acid availability and FM quality. We studied the effect of processing FM under different time and temperature conditions on productive performance of broiler from 1 to 28 d of age. There were six dietary treatments that differed in the type of FM used to replace 5% of the crude protein of the diet. There were a control diet (SFM) that included 8.0% standard FM (100° C for 120 min) and a positive control diet (FMLT) that included 7.1% of spray dried FM (70° C). The remaining four diets included the same original fresh FM that the control SFM diet but in which the FM was processed according to a factorial combination of temperature (80 vs. 90° C) and time (50 vs. 90 min). Each treatment was replicated eight times (10 chicks caged together). The experimental design was completely at random and data were analysed by a protected t–test. In addition two extra non–orthogonal contrasts were included; 1) FMLT vs. SFM and 2) main effects of temperature (80 vs. 90° C) and time (50 vs. 90 min) applied during processing and their interaction. The best BWG and FCR were obtained for broilers fed FMLT or FM processed at 80° C during 50 min but the differences with respect to broilers fed SFM were not significant. The temperature applied during processing had little effect on broiler productivity ($P > 0.10$) but an increase in processing time from 50 to 90 min tended ($P \leq 0.10$) to reduce BWG (52.16 vs. 50.57 g/d) and to impair FCR (1.44 vs. 1.47). We conclude that an aggressive thermal process with an increase in time from 50 to 90 min to reduce microorganism load and Salmonella spp. counts in feed might reduce the quality of fish meal in diets for broilers.

Key Words: Fish Meal, Heat Processing, Broiler Performance

M217 Improved phosphorus utilization in broilers fed phosphorus deficient diets early in life. R. Angel*[1] and C. M. Ashwell[2], [1]*University of Maryland*, *College Park*, [2]*North Carolina State University*, *Raleigh*.

Land application of poultry litter, that is comparatively high in P due to poor utilization of phytin P (PP) by poultry, is of increasing concern in areas of intensive poultry production in the United States. Several strategies have been developed to address this issue, but with variable effectiveness and often increasing production costs, therefore alternative strategies must be explored. To determine the effects of early P nutrition on performance and P utilization male Ross 308 chicks were fed either a control (C) (1.11% Ca and 0.50% PP) or a low (L) (0.59% Ca and 0.25% PP) diet from hatch to 4 d of age (90hr). All birds were then fed a C diet (NRC Ca and P) until d 22. From d 22 to 38 birds were either maintained on a C diet (0.7% Ca and 0.3% P) or an L diet (0.4% Ca and 0.12% P). The three treatments (Trt), C-C-C, C-C-L, and L-C-L met all other NRC (1994) nutrient recommendations. Data were collected for each phase including weight gain, feed conversion, bone ash, and specific nutrient retention. All diets and ileal contents were analyzed for dry matter, P, Ca, PP, and acid insoluble ash. Diet non-PP was determined by subtracting analyzed PP from analyzed P. Apparent ileal absorption of P and Ca, and disappearance of PP were

calculated using an indigestible marker. Broilers fed the L diet to 90 hr were better able to handle a deficiency in P in the grower/finisher phase (22 to 38 d of age) than those fed a C diet in the first 90 hr. Not only were the broilers fed the L diet early heavier (P<0.05) at 38 d of age (2275.6 vs 2235.4 g for the L-C-L and the C-C-L Trt, respectively), but they had better feed efficiency (1.76 vs 1.89 in the L-C-L and C-C-L Trt, respectively), had higher tibia ash and higher P retention (56.54 vs 45.39% for the L-C-L and C-C-L Trt, respectively) than those fed the C diet in the first 90 hr of life. This clearly establishes that "imprinting" or permanent modifications are occurring post-hatch that are long term and allow for improved P utilization when P deficient diets are fed in the grower/finisher phases.

Key Words: Phosphorus, Conditioning, Imprinting

M218 Calcium and available phosphorus levels at 2:1 ratio for growing broiler chickens. S. Bunzen, H. S. Rostagno*, L. F. T. Albino, L. R. Nery, and C. R. Silva, *Viçosa Federal University*, *Viçosa, MG, Brazil*.

The reduction of phosphorus (P) levels in broiler chickens diets will certainly help to decrease costs and P excretion with reduced effect on the environment. There are many interrelationships between calcium (Ca) and P suggesting that nutritional studies should be run evaluating Ca:available P (aP) levels at a constant ratio of 2:1. A study was carried out with the objective of determining the best %Ca:%aP level for broiler chickens from 22 to 35 days of age. A floor pen trial with 1,440 broilers (Cobb 500; 720 males and 720 females) was conducted using a completely randomized block design, in a 2 x 6 factorial arrangement (Gender x 6 %Ca:%aP levels) with eight replicates and 15 birds per experimental unit (pen). The experimental diets were based on corn (0.03% Ca / 0.08% aP) and soybean meal (0.24% Ca / 0.18% aP), supplemented with dicalcium phosphate (24.5% Ca / 18.5% aP) and limestone (38.4% Ca) to obtain 6 %Ca:%aP levels (0.40 / 0.20, 0.50 / 0.25, 0.60 / 0.30, 0.70 / 0.35, 0.80 / 0.40 and 0.90 / 0.45). Weight gain, feed consumption, feed conversion and bone (tibia) parameters (ash, Ca and P from three birds per pen) were evaluated. Feed consumption was not affected (P>0.05) by the experimental treatments. Weight gain improved linearly (P<0.05) to the dietary Ca:aP levels (gain males = 1095.26 + 102.286 aP; R2= 0.64, and gain females = 895.90 + 153.143 aP; R2=0.57) with an improvement of 36 g/male and 44 g/female (highest - lowest gain). Feed conversion of males and females broilers showed a quadratic response (P<0.05) described by the equations; Y = 1.86068 - 0.675337 aP + 0.85 aP 2 (R2 = 0.87) for males, and Y = 1.99459 - 1.44471 aP + 2.01429 aP 2 (R2 = 0.75) for females. Based on feed conversion and using a 95% confidence limit, the recommended levels are: 0.377% aP / 0.754% Ca for broiler males and 0.341% aP / 0.682% Ca for broiler females.

Key Words: Available Phosphorus, Broilers, Calcium

M219 The effects of Quantum™ phytase on broiler chick live performance and tibia ash percentage. M. E. Persia* and M. R. Bedford, *Syngenta Animal Nutrition*, *RTP, NC*.

Chick tibia ash percentage (TAP) is a sensitive measure of the phosphorus adequacy of poultry diets. Three experiments were conducted to determine the effects of two doses of Quantum™ phytase (QP) on TAP and live performance of chickens fed reduced nonphytate phosphorus (NPP) diets. Four experimental diets were utilized including a positive control diet (PC) that met or exceeded all NRC (1994) recommendations, a negative control diet (NC) similar to the PC but deficient in NPP (0.20% NPP) and the same NC diet supplemented with either 250 or 500 FTU of QP/kg (250 and 500, respectively). In all experiments, 12 blocks of either 6 or 12 Cobb x Cobb broiler chicks were assigned to each of the four treatments utilizing a randomized complete block design. Chicks were raised on experimental diets from 0 to 21 d in Petersime battery pens located in an environmentally controlled room. Weight gain and feed intake were recorded for the 21 d period. At the conclusion of the experiment, chicks were sacrificed and the right tibia was collected from four chicks per replicate group for fat-free TAP determination. Data were analyzed using ANOVA and means separated using specific pre-planned contrasts. Over all experiments, chick weight gain and feed intake was reduced 162 and 171g, respectively, when birds were fed the NC compared with PC rations. Phytase supplementation significantly increased weight gain and feed intake of the NC ration, resulting in overall increases of 95 and 128 g for weight gain and 96 and 137 for feed intake with 250 and 500 FTU/kg, respectively. Tibia ash percent was reduced by 8.3, 8.9 and 7.6% units between the NC and PC fed chickens in experiments 1, 2 and 3, respectively. Supplementation of the NC ration with 250 and 500 FTU/kg significantly increased TAP restoring 2.9, 2.3 and 2.7% units and 4.9, 4.3 and 4.8% units, respectively. These data demonstrate the consistent ability of QP to liberate P and increase weight gain, feed intake and TAP of chicks fed NPP deficient diets.

Key Words: Tibia ash, Phytase, Broiler

Nonruminant Nutrition: Weanling Pig Nutrition and Physiology

M220 Dietary nucleotides supplementation improves growth performance of early weaned pigs. D. Martinez-Puig*[1], J. Morales[2], E. Borda[1], C. Piñeiro[2], and C. Chetrit[1], [1]*Bioiberica S.A.*, *Palafolls, Barcelona, Spain*, [2]*PigChamp Pro-Europa*, *Segovia, Spain*.

In the weaning period, transition from sow's milk to the postweaning diet causes the withdrawal of milk nucleotides. Dietary nucleotide are known to be important for the maturation of the gastrointestinal tract and in the development of immune function (Carver et al., 1991). The objective of the present experiment was to study the effect of dietary supplementation of a nucleotide preparation (Nucleoforce Piglets™) on the productive performance of early weaned pigs. 192 suckling piglets of 14 days of age were distributed into two treatments according to the litter and fed with two creep feed diets, one supplemented with the nucleotide preparation (1000 ppm) and the other no supplemented. Piglets were weaned at 21 days of age and consumed the experimental diets till day 35. From day 35 until day 56 all piglets were fed with the same diet. Performance was determined on days 21, 28, 35 and 56. Mortality and faecal consistency were also assessed. During the prestarter period (21 to 35 d), the average daily gain of pigs fed the nucleotide preparation was numerically higher (76.7 g/d; P=0.12) than that of the pigs fed the control diet (53.5 g/d), although no differences were detected on the feed conversion ratio. During the starter period (35-56d), the nucleotide supplementation significantly improved

average daily gain by 20% (P=0.02) and numerically improved feed conversion ratio by 23.7% (P=0.14). There were no significant effects on mortality and faecal consistency, but were numerically better on the nucleotide supplemented group. The overall results suggest that dietary nucleotide supplementation at 1000 ppm significantly improves the performance of early weaned pigs.

Key Words: Dietary Nucleotides, Productive Performance, Weaning Pigs

M221 The effect of soybean oil, tallow and coconut oil supplementation on growth performance, serum lipid changes and nutrient digestibility in weaned pigs. J. H. Cho*[1], H. J. Kim[1], Y. J. Chen[1], J. S. Yoo[1], B. J. Min[1], J. D. Kim[2], and I. H. Kim[1], [1]*Dankook Univ*, *Cheonan, Choong nam, Korea*, [2]*CJ Feed Co. Ltd*, *Incheon, gyeong gi, Korea*.

This experiment was conducted to determine the effect of soybean oil, tallow and coconut oil supplementation on growth performance, serum lipid changes and nutrient digestibility in weaned pigs. One hundred twenty cross-bred [(Yorkshire×Landrace)×Duroc, 6.92±0.01kg average initial BW] were used in a 35 d growth trial. Dietary treatments included CON (5% soybean oil), T0.5 (4.5% soybean oil + 0.5% tallow), C0.5 (4.5% soybean oil + 0.5% coconut oil) and C1.0 (4.0% soybean oil + 1.0% coconut oil). For the whole period and from d 14 to 35, G/F was increased in C0.5 and C1.0 treatments compared with T0.5 treatment(P<0.05). ADG and ADFI were not affected by treatments. On d 14, C1.0 treatment was higher in serum HDL-cholesterol than C0.5 treatment and atherogenic index was increased in C0.5 treatment compared to T0.5 and C1.0 treatments(P<0.05). Digestibility of fat was improved for pigs fed C1.0 diet compared with those fed T0.5 diet on d 35(P<0.05). However, there were no significant differences in digestibilities of DM, N and DE. In conclusion, feeding diets containing soybean and coconut oils in weaned pigs increased feed efficiency and fat digestibility than feeding those containing soybean oil and tallow.

Key Words: Coconut Oil, Tallow, Weaned Pigs

M222 Dietary supplementation with *atractylis macroceohala koidz* polysaccharides enhances growth performance in weaned pigs. Z. Bin*[1], L. L. Li[2], Y. L. Yin[2], H. Z. Peng[1], K. M. Yang[3], T. J. Li[2], Z. P. Hou[2], P. Zhang[2], and G. Y. Wu[1,4], [1]*Hunan Agricultural University*, *Changsha, Hunan, China*, [2]*Institute of Subtropical Agriculture, The Chinese Academy of Sciences*, *Changsha, Hunan, China*, [3]*Hunan Zhenghong Science and Technology Co.*, *Changsha, Hunan, China*, [4]*Texas A&M University*, *College Station*.

This study was conducted to evaluate the effects of *atractylis macroceohala koidz* polysaccharides (AP) on growth performance in weaned piglets. A total of 120 piglets (Landrace x Yorkshine) weaned at 28 d of age (average BW of 7.5 kg) were assigned randomly to 1 of the 5 treatment groups, with 3 replicates and 8 pigs per replicate. The treatments represented dietary supplementation with 0% (control), 0.3%, 0.6% or 0.9% AP, or 0.02% aureomycin (an antibiotic) to corn- and soybean meal-based diet. All pigs had free access to their diets and drinking water. In the first 14-d (28 to 42 d of age) and second 14-d (42 to 56 d of age) phases, dietary supplementation with all dosages of AP did not affect (P>0.05) feed intake bur with 0.6% AP increased (P<0.05) ADG by 7.6% and 18.5%, respectively, compared with the control pigs. In the second phase, the gain:feed ratio was 14.0% higher (P<0.01) in pigs supplemented with 0.6% AP, and the value was 7.4% higher (P<0.05) in piglets supplemented with 0.9% AP, compared with the control and antibiotic-supplemented pigs. In both phases, growth performance did not differ (P>0.05) statistically among pigs supplemented with the 3 dosages of AP. These results indicate that dietary supplementation with 0.6% AP resulted in a most favorable effect on growth performance in weaned piglets. We suggest that AP is an effective alternative to a feed antibiotic for post-weaning growing swine. (Supported by NSFC, CAS, and Hunan Natural Science and Technology Foundation)

Key Words: Polysaccharides, Herbs, Weaned Pigs

M223 Dietary supplementation with Chinese herbal formula affects serum concentrations of amino acids in weaned pigs. X. F. Kong*[1], Y. L. Yin[1], F. G. Yin[1], H. J. Liu[1], F. F. Xing[1], T. J. Li[1], R. L. Huang[1], and G. Y. Wu[1,2], [1]*Institute of Subtropical Agriculture, The Chinese Academy of Sciences*, *Changsha, Hunan, China*, [2]*Texas A&M University*, *College Station*.

This experiment was conducted to determine the effects of dietary supplementation with Chinese herbal formula (CHF) on serum concentration of amino acids (AA) in weaned pigs. Sixty piglets weaned at 21 d of age were randomly assigned to one of the three treatment groups, representing supplementation with 0 (control) or 0.2% CHF, or 0.02% colistin (an antibiotic) to a corn- and soybean meal-based diet (n = 20 pigs/group). On d 7, 14, and 28 after initiation of CFH supplementation, venous blood samples were obtained for the analysis of serum protein and AA using an Auto-Blood Biochemical Analyzer and an Auto-AA Analyzer, respectively. The results indicated that dietary supplementation with CHF increased (P < 0.05) serum concentrations of total protein and albumin as well as ADG, compared with the other two groups of pigs. On d 7, serum concentrations of Phe were higher (P<0.05), but serum concentrations of Ala, Pro, Lys, Arg, Met, branched-chain AA, aromatic AA, and total AA were lower (P<0.05) in CHF-supplemented piglets than in the other two groups of pigs. On d 14, the CHF treatment increased (P<0.05) serum concentrations of Ile, Ala, Glu, aromatic AA, and total AA, compared with the control group and increased (P<0.05) serum concentrations of Asp, Cys, His, Lys, Thr and Met, compared with colistin-supplemented piglets. On d 28, serum concentrations of Ala, Met, branched-chain AA, aromatic AA, and total AA were higher (P<0.05) in CHF-supplemented than in control pigs, and serum concentrations of His and Tyr were higher (P<0.05) in CHF-supplemented pigs, compared with the other two groups of pigs. These results suggest that dietary supplementation with CHF may affect the digestion of dietary protein or whole-body amino acid metabolism, thereby improving growth performance in weaned pigs. (Supported by NSFC and CAS)

Key Words: Chinese Herbs, Weaned Pigs, Amino Acids

M224 Effects of feeding resistant starch on glucose and hormone levels in plasma of weaned pigs. X. Wu*[1], S. Y. Bin[1], G. Y. Wu[1,2], X. F. Kong[1], Y. L. Yin[1], T. J. Li[1], and R. L. Huang[1], [1]*Institute of Subtropical Agriculture, The Chinese Academy of Sciences*, *Changsha, Hunan, China*, [2]*Texas A&M University*, *College Station*.

Two experiments were conducted to determine effects of feeding resistant starch (RS) on concentrations of glucose, insulin, growth hormone (GH), thyroid hormones (T3 and T4), in plasma of the weanling piglet as an model for studying infant nutrition. In Experiment 1, 12 pigs (Duroc×Landrace×Yorkshire) weaned at 28 d of age (BW of 8.8 ± 1.0 kg) were randomly assigned into one of the four treatments, representing control, isonitrogenous (20%), isocaloric (16 MJ/kg), and iso-starch (39%) diets. The four diets were formulated with corn, brown rice, sticky rice and RS as starch sources, with their RS content being 2.29%, 0.94%, 0.00% and 20.64%, respectively. On d 25 of the feeding trial, venous blood samples were obtained at time zero and every 1 h for 12 h. Plasma was analyzed for glucose, insulin, GH, T3 and T4. The results indicated that feeding RS decreased (P<0.05) postprandial plasma concentrations of glucose, insulin, GH, T3 and T4, while sticky rice increased plasma concentrations of glucose and insulin (P<0.05) at 1 h post feeding, compared with the other groups of pigs. Plasma concentrations of insulin in piglets fed the sticky rice diet was 69.2 μU/ml at 1 h post feeding, which was 59%, 74% and 161% higher (P<0.05) than those in pigs fed the corn, brown rice and sticky rice diets, while plasma concentrations of glucose at 1, 2, 3, 6, and 8 h post feeding were lower (P<0.05) than those in the other three groups of pigs. These results suggest that RS is potentially beneficial for improving insulin sensitivity in young pigs. (Supported by NSFC and CAS)

Key Words: Resistant Starch, Weaned Pigs, Plasma Parameters

M225 Effect of adding a wheat dextrin on growth performance of nursery pigs. H. Yang[1], J. Less[2], D. Holzgraefe[1], M. Cecava[1], T. Radke[1], M. Franklin*[1], and C. Sparks[3], [1]*ADM Animal Nutrition Research*, *Decatur, IL*, [2]*ADM Specialty Feed Ingredients*, *Decatur, IL*, [3]*ADM Alliance Nutrition*, *Quincy, IL*.

Two studies were conducted to evaluate whether a wheat dextrin (PremiDex™) improves performance of nursery pigs. In Exp 1, weanling pigs (n=180; BW=4.82 kg) were blocked by initial BW to one of two dietary treatments (TRT), with 18 pens per TRT and five pigs per pen. The TRT were PremiDex (PD) at 0.0 or 0.2% of diet. In Exp 2, weanling pigs (n=150; BW=4.15 kg) were blocked by initial BW to one of five dietary TRT, with six pens per TRT and five pigs per pen. Dietary levels of PD were 0.0, 0.1, 0.2, 0.3, and 0.6%. ADG, ADFI and G/F were measured throughout four phases ending at d 6, 13, 27 and 35 in Exp 1, and d 7, 14, 28, and 42 in Exp 2. Feeds were pelleted in the first two phases and were meal thereafter in both studies. Antibiotic, mannanoligosaccharide (CitriStim™), and acidifier were included in all diets. Addition of 0.2% PD did not affect overall ADG (411 vs. 418 g; P > 0.10) or ADFI (563 vs. 554 g; P>0.10) of nursery pigs in Exp 1, but tended to improve G/F (0.72 vs. 0.74; P=0.076). In Exp 2, increasing PD from 0.0 to 0.6% did not affect ADG, ADFI or final BW (P>0.10). However, pigs fed 0.2% PD were 0.91 kg heavier than pigs fed no PD at the end of the study. PremiDex improved feed efficiency in a quadratic (P=0.01) and cubic (P=0.03) manner. In summary, the test wheat dextrin (PremiDex) improved feed efficiency of nursery pigs.

Table 1.

	% PremiDex						P value		
Exp 2	0.0	0.1	0.2	0.3	0.6	SE	Lin	Quad	Cubic
ADG, g (d 0 to 42)	425	433	444	422	423	14	0.91	0.24	0.83
ADFI, g (d 0 to 42)	670	623	650	618	638	19	0.40	0.19	0.76
G/F (d 0 to 42)	0.64	0.69	0.68	0.68	0.66	0.01	0.54	0.01	0.03
End weight, kg	22.16	22.30	23.07	22.60	22.19	0.50	0.94	0.24	0.85

Key Words: Dextrin, Pig, Prebioitc

M226 Effects of δ-aminolevulinic acid on growth performance, nutrients digestibility, blood characteristics and immune responses of weanling pigs challenged with lipopolysaccharide. Y. J. Chen*[1], J. H. Cho[1], Y. Wang[1], Y. Huang[1], Y. Hyun[2], T. G. Ko[2], and I. H. Kim[1], [1]*Dankook University*, *Cheonan, Choognam, Korea*, [2]*Easy Bio System Inc*, *Cheonan, Choognam, Korea*.

Eighty pigs (BW=7.21 kg) were allotted to 4 dietary treatments with 4 pens per treatment and 5 pigs per pen. Diets were supplemented with 0, 5, 10, or 15 ppm δ-aminolevulinic acid (ALA) of diet and fed for 35 days. Subsequently, 20 pigs were selected from 0 and 10 ppm ALA added treatments (10 pigs in each treatment) and half of those pigs which from same dietary treatment (n=5) were injected with either LPS (50 μg/kg BW) or sterile saline, resulting to a 2×2 factorial arrangement. Blood sample and rectal temperature date were collected at 0, 2, 4 and 12 h after challenge. Growth performance was not affected by treatments during feeding period. Digestibilities of DM and N were improved in 15 ppm ALA added treatment at d 35 (P<0.05). Serum haemoglobin and iron concentrations were increased in 10 ppm ALA added treatment (P<0.05). At d 35, RBC and WBC counts were affected with 5 and 10 ppm ALA supplemented treatments had greatest level (P<0.05). During challenge period, rectal temperature was elevated by LPS injection at 2 and 4 h postchallenge (P<0.05). Plasma cortisol concentration was increased by LPS injection at 2 and 4 h postchallenge and an ALA alleviate effect was exhibited at 2 h postchallenge (P<0.01). Concentration of plasma IGF-I was higher in ALA included treatments at 2 h postchallenge (P<0.05). Injection of LPS elevated plasma TNF-α concentration at 2, 4 and 12 h (P<0.01) while ALA alleviate effect was observed at 2 and 4 h postchallenge. Challenge of LPS decreased WBC counts in blood at 2 and 4 h postchallenge (P<0.01). At 12 h postchallenge, blood cell counts were influenced by LPS challenge while an ALA supplemented effect was only observed on WBC count (P<0.05). In conclusion, dietary supplementation of ALA can improve DM and N digestibilities and attenuate inflammatory response by improving iron status of weanling pigs.

Key Words: Delta-Aminolevulinic Acid, Lipopolysaccharide, Weanling Pigs

M227 Animal performance as influenced by organic acid supplementation into the diet of post-weaning piglets. C. Lückstädt*[1], S. Nitsch[1], N. Kvietkute[2], A. Stupeliene[2], V. Sasyte[2], and R. Gruzauskas[2], [1]*Biomin GmbH*, *Herzogenburg, Austria*, [2]*Veterinary Academy of Lithuania*, *Kaunas, Lithuania*.

During weaning pigs are exposed to a large variety of physiological and environmental stressors. Intensive research has therefore been directed to the potential of natural growth promoters, like organic acids. They have been shown to be effective in reducing the incidence of gastrointestinal disorders, thereby improving growth performance in pigs. Moreover, due to a decrease in gastric pH, acidification of the diets creates favorable conditions for nutrient digestibility, especially in young piglets. The objective of this study was to evaluate the potential of an organic acid blend in post-weaning pig diets regarding its effect on BW, daily weight gain and gain:feed ratio. The trial was conducted in a commercial pig farm under surveillance of the Veterinary Academy of Lithuania. The aim of the trial was to test the acidifier Biotronic®, an organic acid blend consisting of formic acid, propionic acid and their salts on a sequential release medium (3 kg per t of feed), against a commercial piglet diet containing no acidifying additive. Feed and water were available ad libitum. 52 piglets (Pietrain × Yorkshire × Landrace hybrid), 35 days of age, were randomly selected and litter wise allocated to 2 treatment groups. The trial lasted over a period of 28 days. Performance data were measured on a bi-weekly basis. Piglets in the acidifier group weighed 30.77 kg compared with 29.31 kg in the negative control group and the final BW of 63 day old piglets differed numerically (P=0.186). Based on average daily weight gain, a numerical enhancement of more than 11% could be monitored (708 g vs. 634 g for treatment and control, respectively; P=0.115). The G:F was improved by approximately 3% (0.60 and 0.58 for treatment and control, respectively). It can be concluded that the use of the organic acidifier Biotronic® increased numerically performance data of piglets under European production conditions.

Key Words: Organic Acidifier, Piglet Growth, Gain:Feed Ratio

M228 Evaluation of an extruded wheat and milk by–product mixture in diets for early–weaned pigs. B. Vicente, M. P. Serrano, D. G. Valencia, R. Lázaro, and G. G. Mateos*, *Universidad Politécnica de Madrid*, *Spain*.

Condensed lactoserum (CL) is a by-product of the cheese and milk protein industry that results from the ultrafiltration and pasteurization of liquid whey. In a previous study we observed that the inclusion in the diet of 49% of an extruded mixture of CL and wheat (20:80 on DM basis) had little effect on productive performance but increased the incidence of diarrhea (ID). It was hypothesized that the high electrolyte content of CL (2.1% Na and 6.1% K on DM basis) was responsible for the high ID. After ultrafiltration, the electrolyte content of the original CL was reduced by approximately 30%. The ingredient tested in current trial was an extruded mixture (18:82 on DM basis) of CL low in electrolytes and wheat (CL-W). The CL used had 62.5% lactose and 7.7% CP on DM basis. We studied the effect of increasing levels of CL-W (0, 15, 30, 45, and 60%) in the diet on performance of pigs from 24 to 50 d of age and on apparent total tract digestibility (ATTD) of nutrients at 36 d. All diets were isonutritive except for electrolyte content that increased with increasing levels of CL-W (0.27 to 0.39% for Na, 0.51 to 0.71% for Cl, and 1.04 to 1.12% for K for the control and the 60% CL-W containing diets, respectively). Each treatment was replicated seven times (six piglets) and the trial lasted 26 d. From 24 to 34 d of age an increase in CL-W content of the diet increased ADG (L; P<0.05) and tended to improve ADFI and FCR (L; P<0.10). Inclusion level did not affect productive performance from 34 to 45 d of age but from 45 to 50 d reduced ADFI and improved FCR (L; P<0.05). For the entire experiment no differences were found among treatments for any trait studied. An increase in the level of CL-W increased digestibility of all nutrients (P<0.01) except CP. We conclude that reducing the electrolyte content of the condensed lactoserum will allow its use at levels of up to 10.8% in diets for young pigs.

Key Words: Electrolytes, Milk By–Product, Pig Performance

M229 Relationship between texture and preference of cereal based diets in piglets. D. Solà-Oriol[1], E. Roura*[2], and D. Torrallardona[1], [1]*IRTA, Mas de Bover*, *Constantí (Tarragona), Spain*, [2]*Lucta SA*, *Barcelona, Spain*.

We have reported that diet palatability in piglets depends on the cereal source used and its inclusion level. Although the perception of flavor is a combination of taste and smell, texture could be a sensory input that may play an important role in modifying palatability. In the present study we evaluated the relationship between the preference for different cereals and their textural properties as indicator of mouth feel during eating. A series of double choice preference trials was conducted to evaluate the palatability of different cereals compared to a common reference diet (REF) containing 60% rice. A total of 63 diets were tested (5 trials with 3 cereals at 3 inclusion levels and 3 trials with 3 cereals at 2 inclusion levels). In each trial 144 piglets in 36 pens were given simultaneous access to two diets in two feeding hoppers; one with the REF diet and the other with a diet in which different proportions (15, 30 or 60%) of rice were replaced by the different cereals. Preference in each pen was calculated as the percentage contribution of the cereal diet to total feed intake. Additionally, hardness, fragility, chewing work and adhesiveness of each diet were also measured with a texture analyzer. Pearson's correlation coefficients between preference and texture parameters were analyzed using the CORR procedure of the statistical package SAS. Hardness, fragility and chewing work were negatively correlated with preference (Pearson's correlation coefficients: r = -0.51, -0.52 and -0.38, respectively; P<0.01). On the other hand, no correlation was observed between preference and adhesiveness (P>0.1). In conclusion, reducing the hardness and fragility of feed, as well as reducing its chewing work is a way of improving its acceptability in piglets.

Key Words: Cereal Texture, Palatability, Piglet

M230 Effect of processing cereals on feed digestibility and meal retention in piglets. D. Solà-Oriol* and D. Torrallardona, *IRTA. Mas de Bover*, *Constantí (Tarragona), Spain*.

Cereals with a high nutrient digestibility are recommended for piglet diets. Processing of cereals may improve nutrient availability and digestive function. The present trial studied the effect of cereal processing on the digestibility and proximal GIT digesta flow. Eight diets containing 60% of white rice (raw or cooked), whole oats (raw or steam-rolled with hull removal) whole oats (raw or cooked) or naked oats (raw or micronized) were studied. The apparent digestibilities

for CP (ileal) and DM and OM (ileal and faecal) were measured in 24 pigs fitted with an ileal T-cannula in four consecutive 7d-periods, using TiO_2 as indigestible marker (n=12). The fractional meal retention (FMR) in the proximal GIT (estimated from ileal DM flow) was measured in 16 pigs (4 periods) for 28 h after feeding (n=8). FMR as a function of time was fitted with a modified power exponential function $(y(t)=1-(1-e^{-kt})^b)$ for each pig using the NLIN procedure of the statistical package SAS. The emptying rate (k, %/min) and the extrapolated y-intercept (b) from the terminal portion of the curve were obtained, and used to calculate $T_{1/2}$ (minutes to empty half of the contents) and the lag time (T_{lag}, min) by solving t from $\ddot{y}(t)=0$. The effects of cereal and technological process were analyzed using the GLM procedure of the statistical package SAS. Steam rolling with hull removal of whole oats improved (P<0.001) fecal DM (75.1 *vs*. 83.9) and OM digestibilities (78.6 *vs*. 89.1). Moreover steam rolling of whole oats reduced b (P<0.01), $T_{1/2}$ (783 *vs*. 568; P<0.05) and T_{lag} (639 *vs*. 398; P<0.05). Cooking whole oats reduced the ileal digestibilities of DM (61.4 *vs*. 57.2; P<0.01), OM (64.4 *vs*. 61.0; P<0.05) and CP (77.1 *vs*. 72.7; P<0.001). Cooking rice or micronizing naked oats did not affect digestibility or proximal GIT DM flow (P>0.1). It is concluded that the response to cereal processing depends on both the characteristics of the cereal and the technological treatment considered.

Key Words: Piglet, Processed Cereals, Digestibility

M231 Storage affects the palatability of protein sources in piglet diets. D. Solà-Oriol[1], E. Roura*[2], and D. Torrallardona[1], [1]*IRTA. Mas de Bover*, *Constantí (Tarragona), Spain*, [2]*Lucta SA*, *Barcelona, Spain*.

We have shown previously that protein source affects palatability in piglets. Proteins may be affected during storage due to chemical reactions that alter their composition and the release of volatile compounds. Palatability for skimmed milk (SM), soybean protein concentrate (SPC) and potato protein (PP), before or after storage (300d) was evaluated using a double choice preference test vs. a reference diet (REF). Stored SM was used beyond its expiry date, which was not the case for SPC and PP. Each pen (4 pigs) was offered the choice between the REF diet and a protein source diet (in mash form). Protein sources were included at 5, 10 and 20% by replacing a soy protein product (56% CP) from the REF diet. Each pen was offered the same protein source in three consecutive 4d periods testing the inclusions levels of 5, 10 and 20%, respectively. Preference (percentage contribution of the tested protein diet to total intake) was measured for each pen. The preference values were analyzed taking into account the effects of protein source (P), inclusion level (L), storage (S) and their interactions using the GLM procedures of the statistical package SAS. Significant effects for P (P<0.0001), L (P<0.05), S (P<0.0001), PxS (P<0.001) and LxS (P<0.001) were observed (n=9; SD = 14.4). The preferences of the three protein sources were: SM=39, SPC=32 and PP=12%. Preference decreased with increasing inclusion level: 31, 27 and 24%. Storage reduced preference from 37 to 17%. The interaction PxS indicated different reductions in preference due to S for the different proteins: SM (55 vs. 23 %), SPC (42 vs. 22%) and PP (16 vs. 7%). Finally, the interaction LxS indicates that whereas L affected the preference of the non-stored proteins (45, 39 and 30% at 5, 10 and 20%), it did not affect that of the stored ones (18, 15 and 19% at 5, 10 and 20%). It is concluded that storage reduces the palatability of proteins and that the magnitude depends on the protein source independently of its level of inclusion.

Key Words: Piglet, Protein Sources, Palatability

M232 Cereal nutrient composition correlates with feed oro-sensorial perception in piglets. D. Solà-Oriol[1], E. Roura*[2], and D. Torrallardona[1], [1]*IRTA, Mas de Bover*, *Constantí (Tarragona), Spain*, [2]*Lucta SA*, *Barcelona, Spain*.

The taste sensory system provides information on major nutrients such as carbohydrates or proteins, whereas the olfactory sensory system detects feed volatiles. The combination of both will provide the basis for the diversity of flavors found in the diet. Piglet diets are formulated taking into account the nutritional value of feed ingredients from a proximal analysis. Feed oro-sensorial perception can be related with the nutrient availability or composition. In the present work we studied the direct relationship between cereal nutritional values and feed preference. Eight double choice preference trials (36 pens; 4 animals/pen) were conducted using a diet with 60% of white rice as reference (REF). In each trial, three cereals were tested and a double control test (rice vs. rice) was included. Overall, the preference for a total of 24 cereal based diets was obtained. In the test diets all the rice from the REF diet was replaced by the cereal to be tested. Preference was calculated as the percentage contribution of the test diet to total feed intake. For each cereal, dry matter (DM), ash (ASH), crude fibre (CF), ether extract (EE), gross energy (GE) and crude protein (CP) were measured and digestible energy (DE) content was calculated. The relationship between the preference and the nutritional values measured was determined as a Pearson's correlation coefficients using the CORR procedure of the statistical package SAS. No significant (P>0.1) Pearson's correlation coefficients between preference and DM, ASH, EE, GE and CP were observed, however, CF and DE showed linear relationships with preference (r = -0.61 and -0.54; P<0.01, respectively). In conclusion, DE and CF of cereals are directly associated with their palatability. Further studies are required to assess the role of mouth feel associated with CF. Other nutrient-related compounds may better explain the oro-sensorial perception of feed.

Key Words: Cereals Nutrients, Piglet, Palatability

M233 The body weight-related differences of leptin and neuropeptide Y (NPY) gene expression in pigs. T. Z. Shan*, Y. Z. Wang, J. X. Liu, and Z. R. Xu, *Institute of Feed Science*, *Hangzhou, Zhejiang, China*.

To determine if the body weight change is directly related to allered leptin and neuropeptide Y (NPY) gene expression, we assessed the adipose tissue weight, adipose deposition rate, leptin and NPY mRNA levels, serum leptin concentration in pigs weighted 1, 20, 40, 60, and 90 kg. The results indicate that the weight of adipose tissues and the adipose deposition rates of pigs significantly increased and correlated with BW from 1 kg to 90 kg (P < 0.01). Serum leptin concentration and leptin mRNA levels in omental adipose tissue (OAT) increased from 1 to 60 kg, then decreased from 60 to 90 kg. At 60 kg, the serum leptin concentration and leptin mRNA level significantly increased by 33.5% (P < 0.01) and 98.2% (P < 0.01) respectively as compared with the levels at 1 kg. At 60 kg, the amount of leptin mRNA in

subcutaneous adipose tissue (SAT) was significantly higher than that of 1 and 40 kg animals ($P < 0.05$). NPY gene expression also changed with BW and at 60 kg, the NPY mRNA level significantly decreased by 54.0% ($P < 0.05$) as compared with that in 1 kg. Leptin mRNA in OAT correlated with serum leptin concentrations ($r=0.98$, $P < 0.01$), the body weight ($r=0.82$, $P < 0.05$) and fat deposition rate ($r=0.81$, $P < 0.05$). Our results first reported that the developmental expression of leptin in porcine OAT, PAT and SAT, and first proved that the expression of leptin in OAT was the primary source of circulating leptin. These results could provide some information for gene therapy to manipulate leptin secretion, which will lead to practical methods of controlling appetite and growth in farm animals, thereby regulating and improving efficiency of lean meat production and meat production quality.

Key Words: Pig, Leptin, Neuropeptide Y

M234 *In vitro* screening of plant materials as anti-adhesive agents against *E. coli* K88. S. Galletti[1,2], P. G. van Wikselaar[2], D. Tedesco[1], and P. M. Becker*[2], [1]*University of Milan*, *Milan, Italy*, [2]*Animal Sciences Group of Wageningen UR*, *Lelystad, The Netherlands*.

Due to the ban of antibiotics in feeds, alternative ways are needed to improve animal health and performance. A promising strategy is to supply animals with feed ingredients that act as alternative adhesion sites, thus facilitating bacterial shedding from the gut and reducing colonization and infection. In order to screen the ability of different materials as anti-adhesion agents, a microplate-based *in vitro* method was developed. In this test, different feed/food ingredients and plant by-products from the EU project Safewastes were tested for their binding ability towards the pig pathogen *E. coli* K88. ELISA microplates were coated with suspensions of powdered test ingredients in PBS buffer (Safewastes by-products SW1 to SW11, coffee grounds, konjac gum, locust bean gum, sesame seed expeller, tomato, yeast product) and incubated overnight at 4°C. Quenching was done with 1% BSA in PBS as blocking solution. BSA-coated wells were included as control. After filling with BHI broth, plates were incubated at 37°C in the reading chamber of a photometer. The O.D. was automatically read at a wavelength of 650 nm at 15 min intervals. All OD data were processed by non-linear regression analysis (P-NLIN, SAS). Parameters of the sigmoidal growth curves obtained were analysed by GLM procedure (SAS). The test principle was based on an inverse relationship between initial cell densities and the appearance of growth: The higher adhering cell numbers are, the shorter are the detection times of bacterial growth. Testing of different ingredients resulted in rankings according to their adhesive capacity towards *E. coli* K88, the sorting being based on the respective detection time of cell growth. Detection times ranged from 2.43 h (SEM=0.103 h) for the first position (yeast product) to 5.76 h (SW6) for the last one, being 4.47 h for BSA as a control. The yeast product, SW11, sesame seed expeller and SW7 had significantly lower detection times with respect to control ($P<0.05$), and therefore were considered promising anti-adhesive agents against *E. coli* K88. These ingredients were destined for further testing and validation in an *in vivo* trial on challenged pigs.

Key Words: Anti-Adhesion, *E. coli* K88, Plant Materials

M235 Dose response trials of an enhanced milky flavor in a pig nursery program 1: linear and quadratic effects on piglet performance. E. Roura*[1], I. R. Ipharraguerre[1], and D. Torrallardona[2], [1]*Lucta S.A.*, *Barcelona, Spain*, [2]*IRTA*, *Centre Mas de Bover, Constantí, Spain*.

Two trials were conducted in newly weaned 26d-old pigs to study the effect of the addition of an enhanced milky flavor to feed with and without its water-soluble formulation applied to drinking water. In trials 1 and 2 respectively, 192 and 132 piglets (*Landrace* × *Pietrain*) were distributed in four or three blocks of 12 pens according to initial body weight. Pigs were offered free access to 1 of 6 diets differing only in the flavor dose (trial 1: 0, 250, 500, 750, 1000 and 1500 ppm and trial 2: 0, 1000, 2000, 3000, 4000 and 5000 ppm). Additionally, half of the pens were offered flavored water during the first 28 (trial 1) or 14 (trial 2) days postweaning. Single effects of feed treatments for the non-flavored water groups are reported here. At the end of the pre-starter phase (0-14 d postweaning) of trial 1, animals in the 1500 ppm group had the numerically highest ADG (121 g/d) and ADFI (180 g/d). When compared to the control diet, all diets treated with flavor improved ($P < 0.05$) feed efficiency during the starter phase (14-28 days postweaning), but overall (0-28 d postweaning) only the diet treated with 1500 ppm of flavor improved ($P < 0.05$) ADG. However, when only equidistant doses were analyzed (0, 500, 1000 and 1500 ppm), a significant ($P < 0.10$) linear effect was observed for ADG throughout the 28 days. In trial 2 flavor addition in feed resulted in increases in ADG in the pre-starter phase ($P < 0.01$) and overall ($P < 0.05$). At the end of the trial, feed treated with 1000, 2000, 3000 and 5000, but not 4000, ppm of flavor increased ($P < 0.05$) ADG by 21, 21, 19 and 26% respectively compared with the control. In trial 2, the response to increasing flavor dosage was quadratic ($P < 0.01$). It is concluded that adding the enhanced milky flavor to feed results in higher ADG in weanling pigs and that such response is linear at low doses (up to 1500 ppm) but becomes quadratic for the high doses (1000 through 5000 ppm).

Key Words: Flavor, Feed Intake, Piglet

M236 Dose response trials of an enhanced milky flavor in a pig nursery program 2: benefits of flavoring water up to 14 d. E. Roura*[1], I. R. Ipharraguerre[1], and D. Torrallardona[2], [1]*Lucta S.A.*, *Barcelona, Spain*, [2]*IRTA*, *Centre Mas de Bover, Constantí, Spain*.

Two trials were conducted in newly weaned 26-d-old pigs to study the effect of the addition of an enhanced milky flavor to feed and water. In trial 1 and 2 respectively, 192 and 132 piglets (*Landrace* × *Pietrain*) were distributed in four or three blocks of 12 pens according to initial body weight. Pigs were offered free access to 1 of 6 diets differing only in the flavor dose (trial 1: 0, 250, 500, 750, 1000 and 1500 ppm and trial 2: 0, 1000, 2000, 3000, 4000 and 5000 ppm). In addition, half of the pens were offered flavored water (3000 ppm) during the first 28 (trial 1) or 14 (trial 2) days postweaning. In trial 1, adding flavor to water numerically increased ADG by 6% in the pre-starter phase (0-14 d postweaning). However, during the starter phase (14-28 days postweaning) an interaction for ADG ($P < 0.1$) and ADFI ($P < 0.08$) between the addition of flavor to water and feed was observed. In this phase offering flavored water to animals that consumed non-flavored feed increased ADG by 18% and ADFI by 20% compared with pigs offered non-flavored water and feed (negative control). However, offering flavored water to animals that consumed flavored feed did not improve further these parameters. A similar interaction ($P < 0.09$) was

observed for ADFI for the overall trial (0-28 days postweaning). In trial 2, water treatment did not result in significant effects or interactions. Nevertheless, among the water flavored groups, ADG was numerically higher for dietary low doses 0, 1000 and 2000 and lower for dietary high doses 3000, 4000 and 5000 when compared to the non-flavored water groups. It is concluded that addition of an enhanced milky flavor to feed and/or water improves piglet growth in the pre-starter phase. Furthermore, benefits from flavoring feed and water for 14 d postweaning appear to be additive at doses not higher than 2000 ppm in feed.

Key Words: Flavor, Water Intake, Piglet

M237 Response of enterotoxigenic *Escherichia coli* K88 infected piglet jejunal segments to extracts derived from degradation of soybean and canola meal polysaccharides by carbohydrase enzymes. E. Kiarie*, B. A. Slominski, and C. M. Nyachoti, *University of Manitoba*, *Winnipeg, MB, Canada*.

Enterotoxigenic *E. coli* K88 (ETEC) infection results in fluid secretion and electrolyte losses in piglet small intestine. In the present study, effect of perfusing extracts from soybean (SBM) and canola (CM) meals containing polysaccharide hydrolysis products on net absorption was investigated using ETEC-infected jejunal segments. Extracts were generated by incubation of ethanol-extracted SBM and CM with a combination of polysaccharide degrading enzymes including pectinase, cellulase, mannanase, xylanase, glucanase and galactanase activities. Following incubation, the slurries were centrifuged and the supernatants were mixed with absolute ethanol to produce 2 fractions: 80% ethanol-solubles (ES) and 80% ethanol insolubles (EI). Eight pigs weaned at 21 d of age and fed a commercial starter diet for 7 d were held under anesthesia and 10 segments were prepared in jejunum of each pig. Extracts from SBM and CM were studied in 2 independent experiments involving 4 piglets each in which 2 factors were studied: extract type (EI vs. ES) and time of ETEC infection (before perfusion vs. 30 min after perfusion). Pairs of jejunal segments (1 noninfected and the other ETEC-infected) were perfused simultaneously with different extracts during a 7.5 h. In each piglet 1 pair of segments was perfused with saline as a control. Net absorption of fluid and solutes was determined. In both Experiments ETEC-infected segments perfused with saline had the lowest ($P < 0.05$) net fluid and solutes absorption compared with SBM and CM extract. Interaction ($P < 0.001$) between extract type and time of infection was only evident for SBM in which case perfusing ES extracts 30 min before infection resulted in high fluid (835±22 vs. 428±51 µl/cm^2) and solutes (259±7.1 vs. 133±16 µOsmol/cm^2) absorption compared with ETEC infection before perfusion. In conclusion, SBM and CM polysaccharide hydrolysis products were beneficial in maintaining fluids and solutes balance during ETEC infection.

Key Words: Carbohydrase Enzymes, Enterotoxigenic *E. coli* , Piglet

M238 Performance, immune response and intestinal microbial populations of weanling pigs fed diets containing a specially prepared potato protein. Z. Jin[1], Y. X. Yang[1], J. Y. Choi[1], P. L. Shinde[1], T. W. Hahn[1], H. T. Lim[1], Y. K. Park[2], K. S. Hahm[2], and B. J. Chae*[1], [1]*Kangwon National University*, *Chuncheon, Kangwon-Do, Republic of Korea*, [2]*Chosun University*, *Kwangju, Republic of Korea*.

A total of 280 weanling pigs (Landrace × Yorkshire × Duroc) were used in a 28-d growth study to investigate the effects of feeding a potato protein (PP) on growth performance, immunity, and bacterial populations in large intestine. These weanling pigs (initially 6.42±0.74kg and 23±3 d of age) were randomly allotted to five treatments on the basis of their body weight, each treatment comprised of four pens and each pen had 14 piglets. Dietary treatments included: NC (negative control; basal diet); PC (positive control; basal diet + 0.15% apramycin and 0.10% colistin sulfate); PP (basal diet added with 0.25, 0.50 and 0.75% of potato protein). PP was extracted from a special potato breed (*Solanum tuberosum* L cv. Gogu) containing antimicrobial peptides (Potamin-1). PC treatment showed significantly ($P<0.05$) higher ADG than PP, but PP showed linear improvement ($P<0.05$) in ADG and ADFI. The feeding of PP to weanling pigs had no effect ($P>0.05$) on their immune response. The total anaerobic bacteria in caecum and rectum, *Staphylococcus* in caecum and *E. coli* in colon were significantly ($P<0.05$) lower in PC than PP. Similarly, PP had lower (linear, $P<0.05$) total anaerobic bacteria and *Staphylococcus* in caecum, rectum and colon, and *E. coli* in colon than NC, respectively. These results suggest that PP used in this experiment can be a candidate as an animal growth promoter in weanling pigs.

Key Words: Potato Protein, Weanling Pigs, Growth

M239 Decreasing postnatal skeletal muscle protein synthetic activity is associated with a reduction in the expression of S6K1 in fed young pigs. X Yang* and M. Z. Fan, *Centre for Nutrition Modeling, University of Guelph*, *Guelph, Ontario, Canada*.

The objective of this study was to investigate the association between developmental changes of fractional protein synthesis rates (FSR) and the expression of ribosomal protein S6 kinase 1 (S6K1) in the skeletal muscle of fed young pigs. Thirty-six purebred Yorkshire gilts were used at the ages of d 1, 4, 6, 12, 20 and 28 (1 wk post-weaning). Piglets were given intraperitoneally a flooding dose of Phe containing L-[ring-2H5]Phe in saline. Plasma and loin muscle samples at 30 min post-injection were collected for the determination of tracer Phe enrichment by GC-MS. Total and phosphorylated (Thr 389) forms of S6K1 were examined by Western blot. The FSR of skeletal muscle decreased linearly ($P<0.05$) from d 1 (20.8 %/d) to day 28 (5.3 %/d). Linear (total and the phosphorylated forms) and quadratic (phosphorylated form) decreases in S6K1 abundances ($P<0.05$) were observed, and the changes were correlated ($P<0.05$; $r= 0.69$ and 0.59 for total and phosphorylated S6K1, respectively) with FSR at the ages of d 1 to 28. Furthermore, the ratio of the phosphorylated S6K1 to total S6K1 abundance was linearly and quadratically decreased ($P<0.05$) from d 1 to 28 in the fed young pig. These results indicate that the decreasing FSR in skeletal muscle is associated with a reduced expression of S6K1 in fed pigs during the early postnatal growth.

Key Words: Pigs, Ribosomal Protein S6 Kinase 1, Muscle Protein Synthetic Activity

M240 Effect of plant extracts on growth performance and immune status in weaning pigs. H. J. Jung*[1], J. C. Park[1], Y. H. Kim[1], S. Y. Jee[1], S. D. Lee[1], H. D. Jang[1], H. J. Kim[2], I. H. Kim[2], H. K. Moon[1], S. W. Kim[3], I. C. Kim[1], and S. J. Lee[1], [1]*National Livestock Research Institute*, *Cheoan, Chungnam, Republic of Korea*, [2]*Dankook*

University, *Cheoan, Chungnam, Republic of Korea*, [3]*Texas Tech University*, *Lubbock*.

This study was conducted to investigate the effects of plant extracts on growth performance, immune status in weaning pigs. A total of 125 crossbred ([Landrace×Yorkshire]×Duroc) pigs with an initial body weight of 7.05 ± 0.07 kg were used in this 6-weeks experiment. Pigs were allotted to five treatments (five replicates per treatment and five pigs per pen) according to a randomized complete block design. Dietary treatments were : 1) NC (negative control; basal diet), 2) PC (positive control diet; NC diet + 0.1% antibiotics), 3) PL 1 (Control diet + 0.2% Mistole), 4) PL 2 (Control diet + 0.2% Stevia), 5) PL 3 (Control diet+0.2% SMUS®). In overall trial, ADG was increased PL 3 treatment compared with NC and other PL treatment ($p<0.05$). However, blood traits were not affected by treatments. The morphology of small intestine was not affected by pigs fed diets with plant extracts, but villi height and crypt depth of small intestine improved significantly in PL 3 treatment compared with other treatments ($p<0.05$). In conclusion, plant extracts tended to improve growth performance, morphology of small intestine compared with the pigs fed the NC and PC diets.

Key Words: Plant Extracts, Immune, Weaning Pigs

M241 Effect of probiotics in lactating sows diets on sows and litter performance. A. Castellanos A*[1], J. A. Renteria F[2,1], J. A. Cuaron I[2,1], and C. A. Mejia G[2,1], [1]*FES-C UNAM*, *Ajuchitlan, Qro*, [2]*CENIDFA-INIFAP*, *Ajuchitlan, Qro*.

To evaluate the effect of two probiotics on sow and litter performance, 562 sows (257 ± 33 kg) were fed four lactation diets. A Control diet (C) formulated to satisfy the requirements of lactating sows (NRC, 1998) based on sorghum-soy bean meal, a 2nd diet (B) similar to C with the addition of 0.5 kg of a probiotic containing the combination of two bacteria Bacillus Licheniformis and B. subtilis, a 3rd diet (Y) similar to C plus the addition of 3 kg of a probiotic containing Saccharomyces cerevisiae, a 4th diet (BY) similar to C plus the addition of both probiotics. Sows were fed the diets starting on day 100 of gestation and until weaning. Response variables were; feed intake during lactation (total TFI and ADFI), number and weight of born pigs, number and weight of weaned pigs, and weight lose during lactation. Experimental design was a CRB whit factorial arrangement 2x2, the experimental unit was the sow and its litter, and block was the maternity building. Data were analyzed using the GLM of SAS (9.1.3). In TFI during lactation an interaction yeast*bacteria was found ($P < 0.05$, SEM= 2.54) 99.2, 93, 95.2, 101.3 kg for C, B, Y, and BY respectively. For litter weight at weaning an interaction yeast*bacteria was observed ($P = 0.09$, SEM = 1.8375) 54.3, 53.8, 53.3, 60 kg, for C, B, Y and BY respectively. For the number of pigs wean a B effect was observed, ($P < 0.04$, EEM = 0.137) 9.62 vs. 9.12. While for the average weight of wean pigs a Y effect was observed ($P < 0.001$, SEM= 0.079) 6.2 vs. 5.6. For sow weight lose during lactation an interaction yeast*bacteria was observed ($P<0.06$, SEM= 5.45) 19.18, 42.01, 22.42, 28.86 kg; C, B, Y and BY respectively. In conclusion, the combination of both probiotics used in this experiment resulted in an improved litter performance, without affecting sow performance. The inclusion of bacteria probiotic in lactating sows diets increased the number of weaned pigs. The inclusion of yeast in lactating sows diets increasedthe average weight of weaned pigs.

Key Words: Sow, Probiotics, Performance

M242 Evaluation of Concept PR 100 in diets for nursery pigs. J. M. DeRouchey*[1], E. J. Wiedmann[1], M. D. Tokach[1], R. D. Goodband[1], J. L. Nelssen[1], S. S. Dritz[1], and J. Whitehead[2], [1]*Kansas State University*, *Manhattan, KS*, [2]*Concept Nutrition, Ltd*, *Preston, UK*.

Concept PR 100 (CNPR), a plant based protein ingredient with added synthetic amino acids and nucleic acids, was compared to spray-dried animal plasma (SDAP) in nursery pig diets. Two separate experiments, each utilizing 180 weanling pigs (initially 5.51 and 5.15 kg for Exp. 1 and 2, respectively and 21 d of age) were used in 28-d feeding trials. In Exp. 1, five experimental diets were fed which included: 1) Control (no specialty protein source); 2) 2.5% SDAP; 3) 5.0% SDAP; 4) 2.5% CNPR; and 5) 5.0% CNPR. In Exp. 2, diets 1, 2, and 3 were similar to Exp. 1, while a modified CNPR was used at 2.5% and 5.0%, respectively for the 4th and 5th treatment diets. In Exp. 1 from d 0 to 14, pigs fed increasing levels of SDAP or CNPR had improved (linear and quadratic, $P<0.001$) ADG and ADFI. Pigs fed increasing levels of SDAP or CNPR also had improved (linear, $P<0.001$) G:F. When comparing the mean of pigs fed diets containing SDAP versus CNPR, pigs fed SDAP had greater ($P<0.002$) ADG, ADFI, and BW at d 14 compared to pigs fed CNPR. Overall, (d 0 to 28), pigs fed increasing SDAP or CNPR had greater ADG, ADFI and final BW (linear, $P< 0.004$) than pigs fed the control diet. There was no overall growth differences between pigs fed SDAP and CNPR ($P>0.11$). For Exp. 2 from d 0 to 14, pigs fed increasing SDAP had improved (linear, $P<0.01$) ADG, ADFI, G:F. Pigs fed increasing CNPR had improved (quadratic, $P<0.001$) G:F. However, pigs fed SDAP had greater ($P<0.03$) ADG, ADFI, and BW at d 14 compared to those fed CNPR. Overall (d 0 to 28), pigs fed increasing levels of SDAP had greater ($P<0.03$) ADG and tended to have improved ($P<0.08$) ADFI and G:F. Also, pigs fed increasing levels of CNPR had improved (quadratic, $P<0.009$) G:F. There was no overall differences in growth between pigs fed SDAP and CNPR ($P>0.22$). These data indicate that pigs fed SDAP compared with CNPR generally had greater performance during the test period, however these differences were not found at the conclusion of the studies.

Key Words: Swine, Protein Source, Growth

M243 The effect of American alligator (*Alligator mississippiensis*) serum on growth performance of weanling pigs. J. T. Compton*, M. E. Merchant, T. S. Shields, and F. M. LeMieux, *McNeese State University*, *Lake Charles, LA*.

Antibiotic use in the food animal industry is a major concern. The use of antibiotics in animal feed is a common practice. Of the total antibiotic production for both human and animal purposes, approximately 25% is used for food animals and 90% of that portion has been reported as being used in subtherapeutic concentrations (Lehenbauer et al., 2002). Subtherapeutic use in these animals is mainly for improved feed efficiency and growth. Subtherapeutic use in farm production animal diets has been a common practice since 1946 when the addition of subtherapeutic levels of antimicrobials was found to enhance growth in poultry (Moore et al., 1946). Today, consumers are concerned of the potential of bacteria resistance to these antibiotics. If a cost efficient antimicrobial substitute for these traditional antibiotics can be found producers and consumers will benefit. Alligator serum has exhibited antimicrobial properties in vitro (Merchant et al., 2003, 2004, 2005) decreasing bacterial and *Escherichia coli* growth. To our knowledge no in vivo research had been performed to date. The objective of this study was to evaluate the effect of 0.5% alligator serum (AS) on growth

performance of nursery pigs fed diets with or without antibiotics. Weanling pigs (n = 100; 7.44 kg BW) were assigned to one of four dietary treatments with six replications per treatment and three, four, or five pigs per pen. The ADG, ADFI, and G/F were measured at d 7, 14, and 21. Pigs fed diets containing AS had increased ($P < 0.05$) ADG from d 0 to 7 and d 14 to 21, and overall when compared with pigs fed diets without antibiotic.

Key Words: Pigs, Alligator, Antibiotic

M244 Post–weaning development of the microbiota composition and activity in piglets fed diets with wheat bran, wheat middlings or sugar beet pulp. F. Molist*, A. Gómez de Segura, E. G. Manzanilla, J. Gasa, R. G. Hermes, and J. F. Pérez, *Universitat Autònoma de Barcelona*, *Spain*.

To determine the effect of dietary fibrous ingredients on intestinal microbial population and activity, 48 early–weaned (24–25 days) pigs were divided into six dietary treatments: a standard diet (STD) based on corn, barley and soybean protein; or high fibrous diets obtained by replacing some major ingredients of STD with 8% Wheat bran (WB), 8% Wheat middlings (WM), 6% Sugar beet pulp (SBP), 4% Wheat bran and 3% Sugar beet pulp (WB–SBP), or 4% Wheat middlings and 3% Sugar beet pulp (WM–SBP). After 10 and 15 days receiving ad libitum the experimental diets, animals were weighed, sacrificed, and digesta samples from the caecum, colon and rectum were taken. Short–chain fatty acid (SCFA) concentration was determined and microbial counts for enterobacteria and lactobacilli were determined by quantitative–PCR. Inclusion of WB promoted increases in the weight gain of the animals at day 15 (142, 1256, 136, 1164, 700, 1187 g for STD, WB, WM, SBP, WB–SBP, WM–SBP). Wheat bran, either at 8% or 4% promoted a decrease in enterobacteria counts in the caecum (11.1, 9.9, 11.7, 10.8, 8.2 and 11.6 log 16 S rDNA gene copies/g FM) and feces (10.3, 9.2, 11.5, 10.9, 8.7, 11.9 log 16 S rDNA gene copies/g FM for STD, WB, WM, SBP, WB–SBP, WM–SBP, respectively, $P \leq 0.001$) of piglets 15 days after weaning. No significant differences were observed on the lactobacilli counts at d15 or on the microbial counts at d10. The SCFA concentrations increased significantly from d10 to d15 in the caecum and feces. Diets supplemented with SBP decreased the isoacids (isobutyrate and isovalerate) proportions in the caecum of piglets at day 10 after weaning ($P \leq 0.003$) and in the feces at day 15 post–weaning ($P \leq 0.004$), while the inclusion of WB significantly increased the percentage of butyrate in the caecum at d15 (7.14, 14.22, 5.39, 4.63, 12.36, 11.48 % for STD, WB, WM, SBP, WB–SBP, WM–SBP, respectively, $P \leq 0.001$). Results suggest a beneficial shift in the composition and activity of the hindgut microbial population of early weaned piglets fed on diets supplemented with WB.

Key Words: Piglets, Dietary Fiber, Microbial Population

M245 Dietary preference for methionine sources in 8 to 25-kg nursery pigs. T. Ettle[1], M. Rademacher[2], F. X. Roth[3], and R. L. Payne*[2], [1]*BOKU University*, *Vienna, Austria*, [2]*Degussa*, *Hanau, Germany*, [3]*Technical University of Munich*, *Munich, Germany*.

Feed intake during the nursery period of growth is crucial to a pig's growth and development. As such, there is considerable interest about how the ingredients used in a typical nursery pig diet influence feed intake, and if a pig can demonstrate a preference for a particular ingredient. Therefore, the objective of this study was to investigate the dietary preferences of nursery pigs given the choice of diets supplemented with either DL-Met (DLM, 99%) or liquid Met hydroxy analogue (MHA-FA, 88%), which are the commonly used sources of supplemental Met. Mixed-sex pigs with an initial body weight of 8.1 ± 1.0 kg were randomly subdivided into 8 groups of 12 animals each for a 5-wk choice feeding trial. Groups 1 through 4 were fed one of the following treatments: 1) a Met-deficient basal diet (0.25% Met, 0.32% Cys, and 1.36% Lys); 2-3) diet 1 plus 0.1 or 0.2% DLM; or 4) diet 1 plus 0.113% MHA-FA. Treatment groups 5 through 8 were able to choose from pairs of treatment diets, and their treatments were: 5) diet 1 plus 0.1% DLM or 0.113% MHA-FA; 6) diet 1 plus 0.1% DLM or 0.152% MHA-FA; 7) diet 1 plus 0.2% DLM or 0.225% MHA-FA; or 8) diet 1 plus 0.2% DLM or 0.305% MHA-FA. Pigs fed treatments 5 and 6 had higher ($P < 0.05$) ADFI than those fed the Met-deficient basal diet. Pigs in treatment groups 2 through 8 had improved ($P < 0.05$) ADG and feed:gain compared with those fed the Met-deficient basal diet. In the non-choice groups (treatments 1 through 4), feed intake was not influenced ($P > 0.05$) by Met source or concentration. However, in the choice-fed groups, pigs fed treatments 5, 7, and 8 consumed a higher percentage ($P < 0.05$) of their total feed intake from the diets containing DLM than they did from the diets containing liquid MHA-FA. In this trial, pigs expressed a dietary preference for DL-Met when given a choice of supplemental Met sources. Furthermore, this preference may be the result of sensory properties of the diets offered to the nursery pig.

Key Words: Ingredient, Methionine, Pig

Physiology & Endocrinology - Livestock and Poultry: Endocrinology and Metabolism

M246 Hormonal response of bulls to glucose challenge in a segregating family structure. R. Pfuhl*, O. Bellmann, F. Schneider, C. Kühn, and K. Ender, *Research Institute for the Biology of Farm Animals (FBN)*, *Dummerstorf, Germany*.

Cattle of the accretion type (Charolais) and the secretion type (Holstein) differ in their hormonal regulation of nutrient utilization. To deepen the insight in the physiological backgrounds, 65 F_2 cross bulls from five Charolais grandfathers and Holstein grandmothers were investigated to test a potential segregation of their glucose-induced insulin response. Growing bulls showed the highest hormonal activity at the age of eight months due to the onset of puberty. Thus, bulls of five families were subjected to a glucose challenge test at this age. Every bull received a glucose solution intravenous (1g/kg $BW^{0.75}$) via catheter into the jugular vein. Blood samples were taken in the same way before and 7, 14, 21 and 28 minutes after glucose administration. Serum insulin and glucagon concentrations as well as the glucose concentration in the whole blood were recorded. The data were evaluated with the GLM procedure of SAS. All tested bulls showed a characteristic glucose clearance curve ($P=0.9832$). In contrast, the insulin response curve differed and showed high variation between and within the five families. The average serum insulin concentration of family 4 reached greatest values and decreased slower, than in the other families.

Significant differences between the families were found in the serum glucagon concentrations before (P=0.025) as well as 21 minutes (P=0.0098) and 28 minutes (P=0.0063) after glucose infusion. Family 4 showed also the highest average serum glucagon levels before (P=0.05), 7 minutes (P=0.0806), 21 minutes (P=0.0098) and 28 minutes (P=0.0063) after glucose infusion. In conclusion, glucose-challenge test revealed a segregation of energy utilizing mechanisms in F_2 cross bulls. Of particular concern are the bulls of family 4, which shows criteria of a possible insulin resistance and will be subjected to further investigations.

Key Words: Glucose, Insulin, Cross Bulls

M247 Growth hormone on metabolic profile of Nellore bulls of two different ages. L. S. Amorim*[1,4], C. A. A. Torres[1], E. A. M. Amorim[1,4], J. M. Silva Filho[2], J. D. Guimaraes[1], M. M. N. F. Oliveira[3], K. Zorzi[1], and G. R. Carvalho[1], [1]*Federal University of Vicosa*, *MG, Brazil*, [2]*Federal University of Minas Gerais*, *Belo Horizonte, MG, Brazil*, [3]*University of Diamantina*, *MG, Brazil*, [4]*Colorado State University*, *Fort Collins*.

The objective of this study was to evaluate the effects of Growth Hormone (recombinant bovine Somatotropin (r-bST)) on the profiles of blood metabolites from two different ages of Nellore bulls. Sixteen bulls were allocated in a factorial arrangement 2 × 2 (ages: young and adults; and r-bST: 0 and 500 mg) with four animals per treatment. The mean age of the young and adult animals was of 13.37 and 20.62 months. Four animals per treatment received every 14 days, saline solution or 500 mg of r-bST, with a total of nine injections per animal, during a 120 day experiment. Bulls were fed corn silage and concentrated diet on the base of corn crumb and soy, twice a day, supplied in individual stalls. Blood was collected every three days for metabolic evaluation. The datas were analized by ANOVA using Tukey test for to compare medias. The statistical analyses of the data were done for three applications, considering three periods (period 1, 2 and 3). The non-esterified fatty acid (NEFA) concentrations were analyzed by week. Serum cholesterol, total protein and glucose levels were affected by period and by treatment (P<0.05). The NEFA levels were affected by the weeks of collection (P <0.05) but not by r-bST treatment (P>0.05). The GH change blood metabolic of young and adult bulls.

Key Words: Bulls, Growth Hormone, Metabolic

M248 Leptin expression in early- and late-maturing *Bos indicus* heifers. L. F. P. Silva*[1], A. Vaiciunas[1], and L. L. Coutinho[2], [1]*University of São Paulo*, *Pirassununga, SP, Brazil*, [2]*University of São Paulo*, *Piracicaba, SP, Brazil*.

The process of maturation of the hypothalamus and the metabolic signal that triggers puberty are not well understood. Clearly, body weight and adiposity influence age at puberty, and leptin has been proposed to have a permissive role on puberty. Our objective was to test whether early-maturing *Bos indicus* heifers had a higher expression of leptin mRNA in adipose tissues. Among a population of 500 heifers between 20 and 25 months of age, 100 heifers were selected based on breed attributes (Nelore), month of birth, and body weight (280 to 300 kg). These 100 heifers were scored as prepubertal or pubertal according to the presence or not of a palpable corpus luteum (CL). Ten heifers without a CL and ten heifers with a CL received a prostaglandin injection, and according to visual observation of heat and rectal palpation, 6 prepubertal and 6 pubertal heifers were selected for the experiment. These 12 heifers were slaughtered and samples of subcutaneous, omental and perirenal adipose tissues were collected and frozen in liquid nitrogen. Expression of leptin was quantified by real-time PCR using the ribosomal protein RP-L19 as a reference gene. Heifers that attained puberty earlier had significant higher expression of leptin by the adipose tissues ($P<0.05$), and there was a significant treatment by tissue interaction. On average, leptin expression was increased 14.7-fold in early-maturing heifers. Early-maturing heifers had higher leptin expression in the omental fat depot (90-fold increase) and in the subcutaneous fat depot (39-fold increase), while there was no effect on leptin expression in the perirenal fat depot (1.5-fold increase). Regardless of the treatment effects, leptin expression was higher in the perirenal fat depot than in the other two tissues ($P<0.01$). Leptin expression was 115-fold higher in the perirenal fat depot then in the other two depots. These results support the idea that circulating levels of leptin is an important signal for the initiation of puberty, and suggest that heifers with higher leptin expression in the adipose tissue could attain puberty earlier, with a lighter body weight.

Key Words: Bovine, Leptin, Puberty

M249 Changes in antioxidant status in beef cows during weight loss and weight maintenance. K. M. Brennan*, J. J. Michal, R. Collins, and K. A. Johnson, *Washington State University*, *Pullman*.

To investigate the impact of β-oxidation on the enzymes, metabolites and genes that are involved in regulation of mitochondrial antioxidant status, Angus and Angus-cross cows (n=26) were examined during weight loss and weight maintenance or small weight gain. The weight maintenance (M) period occurred after weaning. The weight loss and fat mobilization period (L) occurred during lactation. Cows were weighed and condition scored weekly during the 60d period. Tail vein blood samples were collected at both intake levels at the end of the period and immediately processed to yield serum and red blood cell lysate. Serum nonesterified fatty acid (NEFA) concentrations were measured spectrophotometrically using NEFA-C (HR) kit (Wako Chemicals). Superoxide dismutase activity (SOD), an antioxidant enzyme, in red blood cell lysate was measured spectrophotometrically using a Cayman chemical assay kit. During L, cows lost approximately 77 kg of body weight (P>.0001). At the M level of intake cows maintained or gained a slight amount of body weight (approximately 13 kg). Serum NEFA concentration was significantly higher during L than M (P <.001). Average serum NEFA levels at L and M were 0.511± 0.167 and 0.102 ± .031, respectively. SOD activity in red blood cell lysate was greater in L than M (P<.025). Mobilization of body fat, as reflected by body weight loss and serum NEFA levels, results in greater antioxidant activity in red blood cells.

Key Words: Beef Cattle, Antioxidants, Oxidative Stress

M250 Plasma ghrelin concentrations of beef cattle consuming a similar amount of dietary energy supplied by different dietary ingredients. A. E. Wertz-Lutz*[1], J. A. Clapper[1], J. S. Thurlow[1], D. C. Beitz[2], and A. Trenkle[2], [1]*South Dakota State University*, *Brookings*, [2]*Iowa State University*, *Ames*.

Previous research demonstrated that varying caloric intake by manipulating DMI of high-grain diet influenced plasma ghrelin concentrations in cattle. To determine if dietary ingredient composition influenced plasma ghrelin, insulin, NEFA, and GH concentrations when caloric intake was similar, five steers (589±18.1kg) were used in a crossover design. Dietary treatments were 50% hay-50% concentrate **(HAY)** offered at an amount that met the steer′s maintenance requirement plus supplied an additional 3.5 Mcals of NEg daily, or a diet composed of 10% hay-90% concentrate but limit-fed to achieve a caloric intake similar to that of the HAY steers **(LFC)**. On d 21 following initiation of the dietary treatment, serial blood samples were collected via indwelling jugular catheter at 15-min intervals. Following period 1, steers were weighed, dietary treatments were switched between groups, and intake amounts were recalculated. Sampling period 2 was initiated as described for period 1. Plasma samples were assayed for ghrelin, insulin, GH, and NEFA, and, subsequent to analyses, data were pooled by hour for statistical analyses. Hormone data were analyzed statistically as repeated measures in time using the MIXED procedure of SAS. The NEg was similar between treatment groups (3.5 ± 0.04 Mcals NEg/d). However, a higher DMI (P≤0.001) was required by HAY steers compared with LFC steers (9.4 vs. 7.2± 0.06 kg) to achieve the same caloric intake. Plasma ghrelin concentrations were similar (P=0.12) for HAY and LFC steers (115 vs. 107±3.3 pg/mL), and plasma GH, NEFA, and insulin concentrations were similar regardless of dietary treatment. These data are consistent with the hypothesis that ingredient composition and quantity of DM consumed do not influence plasma ghrelin concentrations of steers when caloric intake is similar and steers are in positive energy balance.

Key Words: Beef Cattle, Energy Intake, Ghrelin

M251 Impact of metabolic acidosis on amino acid metabolism in lambs. S. L. Greenwood*[1], T. C. Wright[1], J. Gilmore[1], J. E. Las[1], N. E. Odongo[1], O. AlZahal[1], A. K. Shoveller[1], J. C. Matthews[2], and B. W. McBride[1], [1]*University of Guelph*, *Guelph, Ontario, Canada*, [2]*University of Kentucky*, *Lexington*.

Feeding high amounts of concentrate to ruminants commonly leads to increased production of volatile fatty acids (VFAs) and lactate in the rumen. Metabolic (systemic) acidosis occurs in ruminants as a result of increased absorption of these VFAs and lactate. Furthermore, metabolic acidosis results in high levels of protein degradation of the skeletal muscle in many species, a response thought to alter the concentration of plasma L-amino acids to increase plasma buffering capacity and renal catabolism of glutamine. The objective of this study was to characterize the effect of metabolic acidosis on plasma amino acids of lambs. Ten fully fleeced Rideau-Arcott wether lambs (54.3 ± 6.7 kg body weight) were randomly allocated to balanced treatment groups that were fed diets that contained either 1) a canola meal supplement (control; CS) or 2) a HCl-treated canola meal (NutriChlor) supplement to induce metabolic acidosis (AS). Lambs were fed daily at 0700 and 1100 h. Blood samples were collected daily between 1100 and 1130 h throughout the experimental period (d 0 to d 10) via jugular catheters and were pooled within animal from d 4 to d 10 for analysis. Lambs were slaughtered on d 11 and kidney, liver, and muscle samples were collected from each animal. Plasma serine (19%), glycine (32%), and glutamine (14%) concentrations were increased (P<0.05) in acidotic lambs compared to control animals. This pattern and magnitude of altered plasma amino acid profiles suggests that protein degradation was increased in acidotic sheep. Ongoing Northern blot analyses to identify altered expression of components of the ubiquitin protein degradation system by kidney, skeletal muscle, and liver should reveal tissue-specific mechanisms responsible for the observed shifts in intra-organ amino acid metabolism. These findings suggest that future formulation of high-starch diets need to compensate for metabolic acidosis-induced shifts in amino acid metabolism.

Key Words: Metabolic Acidosis, Ruminant, Protein Degradation

M252 Palmitate and CLA isomer effects on gene expression in MDBK cells. B. J. Thering*, M. Bionaz, and J. J. Loor, *University of Illinois*, *Urbana*.

A time course experiment was conducted to evaluate effects of 150 µM of Wy-14643 (WY, PPARα specific agonist) and 16:0 on CPT1A, ACADVL, ACSL1, LPIN1, PPARGC1A, SREBF1, and RPS9 (reference gene) expression by qPCR. Two replicate cultures were harvested at 0, 6, 12, 18, and 24 h. ANOVA using MIXED was used for statistical analysis. In a second experiment cells were treated for 18 h with 16:0 (150 µM), c9t11CLA (200 µM), and t10c12CLA (200 µM) plus control (CTR). Each duplicate treatment was pooled for microarray analysis using a 13K-gene bovine oligoarray platform using a dye-swap design. Microarray data were analyzed with a ≥2-fold change cut-off relative to CTR. In the time course experiment, expression of all genes except SREBF1, increased ($P < 0.05$) over time with both WY and 16:0. ACSL1 and LPIN1 experienced a treatment × time effect, such that expression of both genes peaked between 6 and 12 h with 16:0, and at 18 h with WY. CPT1A and ACADVL reached peak expression at 18 h and PPARA and PPARGC1A at 24 h. Except for CPT1A and PPARGC1A, expression of all other genes was higher with 16:0 vs. WY, particularly LPIN1 (7-fold at 6 h). Compared to CTR, microarray data showed 29, 47, and 43 genes with ≥2-fold difference due to 16:0, c9t11CLA, and t10c12CLA, respectively. Ingenuity Pathway analysis showed that genes affected by c9t11CLA were associated with lipid metabolism (6 genes, e.g. ADFP (up), SCD (down), FABP3 (down)) and cell signaling and morphology (7 genes, e.g. SPP1 (up), ITGA2 (up)). Genes affected by t10c12CLA were associated with lipid transport and metabolism (11 genes, e.g. ADFP (up), SCD (down), HMGCS1 (down), SC4MOL (down)) and cellular growth (9 genes, e.g. SPP1 (up), IGF1 (up)). Palmitate affected genes involved primarily in cellular growth and among these, SPP1 and G1P2 had the highest difference (≥10-fold). Results suggest 16:0 activated genes through PPARA, and had greater potency in stimulating expression than WY. Marked stimulation of LPIN1 and SPP1 by 16:0 revealed an unknown, PPARA-independent mechanism on gene expression. CLAs affected expression of unpredicted genes involved in pathways of lipid metabolism and cellular growth/morphology.

Key Words: Genomics, Nutrition, Lipids

M253 Transcriptional regulation of mammary and adipose tissue gene expression in dairy cows fed a milk fat-depressing or milk fat-enhancing diet. B. J. Thering*, D. E. Graugnard, P. Piantoni, R. L. Wallace, R. E. Everts, S. L. Rodriguez-Zas, H. A. Lewin, and J. J. Loor, *University of Illinois*, *Urbana*.

To better characterize mammary (MG) and adipose (AT) tissue gene networks regulating lipid synthesis and other cellular processes that

might be responsive to dietary lipid, we biopsied MG (n = 6/diet) at 0, 7, and 21 d, and AT (n = 3/diet) at 21 d of feeding mid-lactation cows (n = 6/diet) a milk fat-depressing (MFD, fish/soybean oil (1:2) at 3.5% of DM), milk fat-enhancing (MFE, EnergyBooster100, 3.5% of DM), or control (no added lipid) diet for 28 d. Milk composition was examined daily. A 13,257 bovine oligonucleotide (70-mers) array and qPCR were used for transcript profiling. Annotation was based on similarity searches using BLASTN against human, mouse and bovine RefSeq, human, mouse, and bovine UniGene, and bovine TIGR. Cy3- and Cy5-labelled cDNA from MG or AT and a reference standard were used for hybridizations. Milk yield was not affected by diets (29 ± 1.7 kg/d), but milk fat % (FP) decreased ($P < 0.001$) gradually (3.73% to ~2.50%) with MFD and reached a nadir essentially by d 13 of feeding. MFE did not increase FP above controls and averaged 3.71%. ANOVA (FDR-adjusted P ± 0.10) identified 797 differentially expressed genes in MG over time due to MFD, and 378 genes in AT due to diet. Among genes in MG, we found 74 downregulated and 171 upregulated by ≥1.5-fold on d 21 vs. 0. In AT, MFD and MFE compared with control resulted in 57 and 35 genes with ≥2-fold up or downregulation. Ingenuity Pathway Analysis of d 21-upregulated MG genes identified cell growth/proliferation (35 genes), molecular transport (22), cell assembly/organization (18), and cell signaling (15) as modified families of related genes. Overall, results suggest that milk fat depression is associated with previously-unknown adaptations in gene networks both in MG and AT. Gene expression in AT seemed responsive, via direct or indirect mechanisms, to both dietary lipids and reduced energy output in milk.

Key Words: Genomics, Lipid, Nutrition

M254 Effect of growth hormone on expression of metabolic genes in adipose tissue of dairy cows. M. Baik[2], J. L. Liesman[1], B. E. Etchebarne[1], J. Bong[2], and M. J. VandeHaar*[1], [1]*Michigan State University*, *East Lansing*, [2]*Chonnam National University*, *Gwangju, South Korea*.

We recently developed a new bovine specific microarray that is targeted for studies on metabolic regulation in cattle. This array (BMET) is a long oligo spotted array of 2400 genes with 4 replicate spots per gene. Our objective in this study was to determine the influence of bovine growth hormone (GH) on the expression of individual genes and gene pathways associated with metabolism and metabolic regulation in adipose tissue of lactating cows. Primiparous Holstein cows were treated with 0 or 29 mg of GH per day, and omental fat was collected at slaughter on day 60. RNA was isolated from adipose tissue of 3 cows treated with GH and from 3 matched controls. Direct comparisons of the treatments were made using two arrays for each cow comparison with a reversal of dye assignments for the second array; a total of 6 arrays were performed. Approximately 9% of the genes were altered at the $P < 0.05$ level, and the distribution of P-values was highly skewed toward the lower P values, indicating a significant treatment effect. Approximately 100 genes were down-regulated. These included several genes associated with glucose transport and activation, fatty acid synthesis, the TCA cycle and NADPH generation, as well as steroyl-CoA desaturase, LDL receptor, and leptin. Approximately 120 genes were up-regulated. These included several genes for protein modification for several signaling pathways, zinc fingers, as well as PPAR alpha, SOCS1 and 5, and IGFBP3. In addition, several genes associated with insulin signaling were altered by GH. Pathway analysis is ongoing. The overall effects of GH were consistent with previously published results. GH decreased activity of many enzymes that would explain the major decrease in fatty acid synthesis and esterification that occurs in adipose tissue during GH administration.

Key Words: Gene Expression, Growth Hormone, Metabolism

M255 Growth hormone receptor expression in two dairy breeds during the periparturient period. C. S. Okamura, J. F. Bader, T. C. Cantley, and M. C. Lucy*, *University of Missouri*, *Columbia*.

The somatotropic axis is implicated in the profound physiological and metabolic changes that accompany parturition and the onset of lactation in dairy cattle. In Holstein cows, the expression of the primary growth hormone receptor (GHR) mRNA in liver, GHR1A, declines dramatically within one week after calving. When Angus beef cows were sampled, however, GHR1A mRNA amount did not change after calving. The present study tested whether the decrease in GHR1A was a characteristic of the Holstein breed alone or whether a second dairy breed (Guernsey) also experienced a decrease in GHR1A after calving. Holstein (n = 9) and Guernsey (n = 9) cows were paired by parturition date. Liver biopsies were taken prepartum (d -20±1) and postpartum on d +3, and d +14±1. Liver RNA was isolated and reverse transcribed (RT) into cDNA. A quantitative RTPCR assay was used to measure the amount of GHR1A, GHR1B and IGF-I mRNA. Heterogeneous nuclear RNA (hnRNA; precursor of mRNA) was also measured to infer rates of transcription for GHR transcripts. There was no effect of breed on GHR1A, GHR1B or IGF-I mRNA amount ($P > .10$). Both Holstein and Guernsey cows underwent a decrease and subsequent increase in GHR1A and IGF-I mRNA from d -20 to +14 [15.6, 2.8, and 8.4 (±1.4) for GHR1A and 12.3, 2.2, and 5.9 (±.9) for IGF-I on d -20, +3, and +14, respectively; effect of day, $P<.001$]. There was no effect of day on hnGHR1A. The change in GHR1B was opposite to GHR1A because GHR1B increased on d+3 [12.8, 25.8, and 15.1 (±3.8); day, $P<.05$]. The hnGHR1B also increased on d+3 (day, $P<.05$). The decrease in GHR1A expression after calving occurred in two dairy breeds that have undergone independent selection for milk production. Reduced GHR1A after calving may be an inherent characteristic of dairy cows that enables nutrient partitioning for greater milk production. The decrease in GHR1A mRNA may arise from a mechanism involving enhanced mRNA turnover because the amount of its precursor mRNA (hnGHR1A) did not change in periparturient cows.

Key Words: Growth Hormone Receptor, Dairy

M256 Effects of milk replacer composition on selected blood metabolites and hormones in pre-weaned Holstein heifers. K. M. Daniels*, S. R. Hill, K. F. Knowlton, R. E. James, R. E. Pearson, M. L. McGilliard, and R. M. Akers, *Virginia Polytechnic Institute and State University*, *Blacksburg*.

We investigated the effects of increasing dietary protein and energy on the concentrations of selected blood metabolites and hormones in Holstein heifer calves. Twenty-four heifers were fed one of four milk replacer (MR) diets (n=6/diet): 20:20 (20% CP, 20% fat MR fed at 450 g/d), 28:20 (28% CP, 20% fat MR fed at 970 g/d), 28:28L (28% CP, 28% fat MR fed at 970 g/d), and 28:28H (28% CP, 28% fat MR fed at 1460 g/d). Calves arrived at the Virginia Polytechnic Institute and State University Dairy Center August 20, September 10, or September 25, 2005. Calves were fed twice daily; water and starter (20% CP)

were available at all times, and any orts were recorded daily. Serum and plasma aliquots from blood samples collected twice weekly after a 12 h fast were analyzed for insulin-like growth factor-I (IGF-I), growth hormone (GH), insulin, glucose, NEFA, triglycerides (TRI), and plasma urea nitrogen (PUN). Calves fed 20:20 had the lowest overall glucose concentration (83, 103, 107, and 107±2 mg/dl for 20:20, 28:20, 28:28L, and 28:28H). Calves on treatments 28:20, 28:28L, and 28:28H increased linearly in blood IGF-I (53 to 126 ng/ml) and decreased in TRI (0.20 to 0.13 mmol/l) over time. Calves fed 20:20 however, demonstrated quadratic IGF-I and TRI responses over time, with lowest values reported at week 4 for IGF-I (20 ng/ml) and week 6 for TRI (0.14 mmol/l). Change in insulin over time was quadratic with the lowest value (0.16 ng/ml) occurring at week 6; GH decreased linearly from 9.8 to 3.8 ng/ml. No differences were detected in PUN concentrations (mean = 7.35 mg/dl of urea N). Plasma NEFA decreased over time in all calves (0.42 to 0.37 mmol/l). Overall, the blood parameters measured here did not depend on treatment diet composition; differences in body composition and calf growth (reported elsewhere) in these animals may likely be explained by variables not measured here.

Key Words: Blood Metabolite, Calf, Milk Replacer

M257 Circulating glucose responses in early lactation dairy cows to dietary restriction and rbST treatment. A. Basson and N. H. Casey*, *University of Pretoria*, *Pretoria, South Africa*.

Galactopoietic effects of somatotropin are the result of IGF-I and require high-quality nutrient intake. This study investigated short-term partitioning effects during recombinant bovine somatotropin (rbST) administration in high yielding early lactation dairy cows. Administration of rbST has been shown generally to alter results of metabolic tests in the face of unchanged basal glucose and insulin concentrations. Ten multiparous Holstein cows were subjected to rbST (LactotropinÒ) and/or feed intake restriction to 80% of predicted ME requirement (80% ME). Responses to insulin challenge (0.1 IU canine insulin/kg BW, 210 min) and hyperglycemic clamp (+50 mg/dL whole blood, 120 min) were tested during weeks 8 (control), 9 (rbST), 11 (80% ME) and 12 (rbST + 80% ME) post partum. Plasma and whole blood samples were assayed for glucose concentrations. The rbST treatment decreased fasting glucose concentration by 10.0% ($P<0.0001$), which was likely a remnant of control hyperglycemia. Maximum glucose response was 4.0 mg/dL lower ($P<0.0148$) and took 6.5 min longer to attain ($P<0.0112$). Steady state glucose infusion rate (SSGIR) decreased by 8.1% ($P<0.0001$). The 80% ME treatment decreased glucose availability by 4.9% ($P<0.0001$), while no glucose responses were affected. Restricted energy intake during treatment with rbST resulted in plasma glucose increase by 5.5% ($P<0,0001$). Peripheral uptake and utilization of glucose increased by 5.1% ($P<0,0001$). Compared to energy restriction, 80% ME + rbST did not alter effects of nutrient restriction on responses to exogenous insulin challenge. Effects were small and inconsistent. SSGIR decreased by 5% in the 80% ME + rbST compared to the 80% ME period ($P<0.0001$) and the change in the hyperglycemic clamp in the absence of an effect in the insulin challenge may be due to differences in endogenous insulin secretion. The conclusion was that rbST treatment resulted in altered glucose metabolic responses, even with restricted energy intake.

Key Words: Glucose, rbST, Dairy Cows

M258 Alterations in hepatic gene expression profiles in dairy cows in response to L-carnitine and feed restriction. D. B. Carlson*, J. K. Drackley, M. Bionaz, S. L. Rodriguez-Zas, N. A. Janovick Guretzky, R. E. Everts, H. A. Lewin, and J. J Loor, *University of Illinois*, *Urbana*.

Previously we showed that abomasal carnitine infusion increases hepatic fatty acid oxidation and decreases liver lipid accumulation during acute feed restriction (J. Dairy Sci. 89:4819-4834). Further, carnitine has been shown to stimulate hepatic gluconeogenesis in nonruminants. Our objectives were to determine global gene expression patterns in liver using a microarray consisting of 7,872 bovine cDNA inserts and qPCR. Eight lactating Holstein cows were used in a replicated 4 × 4 Latin square design with 14-d periods. Treatments were factorial combinations of dry matter intake (DMI) restriction and abomasal carnitine (20 g/d) infusion: water infusion + ad libitum DMI (WA), water infusion + restricted DMI (WR), carnitine infusion + ad libitum DMI (CA), carnitine infusion + restricted DMI (CR). Annotation was based on similarity searches using BLASTN against human, mouse and bovine RefSeq, human, mouse, and bovine UniGene, and bovine TIGR. Cy3- and Cy5-labelled cDNA from liver tissue and a reference standard were used for hybridizations. ANOVA (FDR-adjusted $P \leq 0.10$) identified 248, 655, and 362 differentially expressed genes due to L-carnitine infusion, feed restriction, and their interaction, respectively. Hierarchical clustering indicated that L-carnitine infusion resulted in 26% difference and feed restriction in 37% difference in global gene expression patterns. The CR treatment affected gene expression patterns by 20% relative to WR. qPCR confirmed downregulation ($P \leq 0.05$) of CPT1A, ADIPOR2, and PCK1 by carnitine infusion. In addition, qPCR confirmed ≥2-fold upregulation ($P \leq 0.05$) of PC by feed restriction compared with ad libitum-fed cows, whereas PDK4 expression increased in WR but not CR cows. Gene expression and in vitro liver metabolism data indicate that L-carnitine altered hepatic responses to feed restriction, likely by effects on acute regulatory mechanisms of enzymes associated with fatty acid oxidation and gluconeogenesis.

Key Words: Liver, Microarray, L-carnitine

M259 Hepatic gene expression profiling in postpubertal Holstein dairy heifers. J. Doelman*, N. G. Purdie, H. Cao, L. E. Wright, N. A. Karrow, and J. P. Cant, *University of Guelph*, *Guelph, Ontario, Canada*.

The liver is central to the nutritional response of animals to nutrient supply. The objective of this study was to evaluate the effects of a negative energy balance on hepatic gene expression in Holstein heifers. One-hundred postpubertal heifers between 9 and 13 months of age were randomly assigned to a fed or a 24-hour feed withdrawal treatment under a randomized block design. Liver biopsies and blood samples were taken to obtain RNA for microarray analysis and blood plasma for metabolite and hormone analyses. Spectrophotometric assays were used to quantify plasma concentrations of non-esterified fatty acids (NEFA) and beta-hydroxybutyrate (BhB); statistical analysis was conducted using one-way ANOVA. Plasma NEFA concentrations were significantly higher in fasted heifers ($P<0.0001$), while BhB levels were significantly lower ($P<0.0001$) with the 24-hour feed withdrawal. A cDNA microarray consisting of 8800 oligonucleotide inserts was used to identify hepatic transcript profiles. Array elements were selected from a database of bovine ESTs. A reference design was employed to compare Cy-5 labelled RNA from liver to Cy-3 labelled

RNA from reference standard (derived from bovine liver, spleen and placenta). Gene Spring analysis software was used for LOWESS normalization procedures and statistical analysis (ANOVA, P = 0.05). Sixty-six differentially expressed genes were found using Benjamini and Hochberg's False Discovery Rate (P = 0.05). Forty-two genes were found to be 4.0 to 1.5 fold lower and twenty-four were 1.5 to 2.6 fold greater with feed withdrawal. Down-regulated genes were associated with cell cycle progression or cytolysis, endocytosis, cholesterol synthesis, TCA cycle, immune response and the protein synthetic pathway. Genes associated with gluconeogenesis and fatty acid synthesis suppression, fatty acid transport, TCA cycle, cell structure and transport, and immune response were up-regulated with restricted energy intake. These results are indicative of a hepatic gene response to energetic status in postpubertal dairy heifers.

Key Words: Liver, Gene Expression, Dairy Heifer

M260 Effects of feed restriction on lipogenic gene expression in liver of broiler chickens. H. K. Kang, E. J. Chae, I. S. Jang, S. H. Sohn, and Y. S. Moon*, *Jinju National University*, *Jinju, Korea*.

Ross male broiler chickens were used to determine the effect of either energy restriction (ER) or quantitative feed restriction (QFR) on hepatic expression of the lipogenic genes. Diet restriction in all experiments was accomplished by providing chicks with 70% or 85% energy level of control (ER70, ER85), and 70% or 85% feed intake of control (QFR70, QFR85). Diet restriction groups of chickens were restricted for 7days, starting at 8 days of age. Ad libitum feeding was resumed after the restriction periods, and continued through the end of the experiment at 35 days of age. A control group was fed ad libitum throughout the experiment. Chickens were sacrificed and samples of liver were collected at 14 and 35 days of age. After completion of feed restriction, the body weights of QFR70 and ER70 were the lowest and followed by QFR85 and ER85 ($P<0.05$). However, complete compensatory growth by feed restricted birds relative to controls was achieved by 35 days of age in all treatment groups. Hepatic expression of fatty acid synthase (FAS) gene from QFR70 and QFR85 was 2.7 and 2.1-fold lower than that of control at 14 days of age whereas ER groups were not different from the control group. The FAS gene expressions in QFR groups and ER70 were not completely caught up the control group at 35 days of age while its expression of ER85 was 26% higher than that of control. CEBP/α and PPARγ were the potent transcription factors to stimulate FAS gene at 35 days of age. The expression levels of SREBP-1 were not different between treatment and control groups after compensatory growth. The results of this study indicated that feeding regimen alters expression of lipogenic genes in liver and may influence lipid metabolism of broilers.

Key Words: Feed Restriction, Hepatic Gene Expression, Broilers

M261 Purification of Japanese quail prolactin and detection of multiple glycosylated isoforms. N. Kansaku*[1], G. Hiyama[1], T. Murata[2], T. Sasanami[2], and D. Zadworny[3], [1]*Azabu University*, *Sagamihara, Japan*, [2]*Shizuoka University*, *Shizuoka, Japan*, [3]*McGill University*, *Ste. Anne de Bellevue, Canada*.

Prolactin (PRL) is mainly produced in the cephalic lobe of the anterior pituitary gland and affects a variety of physiological functions in birds. We previously cloned and sequenced PRL cDNA of Japanese quail (AB162003). Since galliform PRL has no consensus sequence for N-linked glycosylation (Asn-X-Ser), an alternative glycosylation site (Asn-X-Cys) for N-glycosylation has been proposed. In Japanese quail, this site is located at position 56 of mature PRL. In general, receptor binding and activation is greatly reduced by glycosylation. However, it is unkown if PRL is glycosylated in the Japanese quail. Accordingly, this study examined the purification of PRL from laying Japanese quail. Anterior pituitary glands were collected from 6 month old Japanese quails (n=500), homogenized and PRL was purified by affinity chromatography using monoclonal antibody against recombinant chicken PRL. The purified PRL was separated by SDS polyacrylamide gel (SDS PAGE) and visualized by Coomassie brilliant blue G-250 staining. Japanese quail PRL consisted of at least three protein bands with molecular sizes estimated to be between 23 to 25 kDa. Western blot analysis using polyclonal antibody against chicken PRL detected similar bands to Coomassie brilliant blue staining. Interestingly, different signal intensity was obtained using various lectins (ConA, DBA, LCA, PHAE4, RCA120, UEFA-I, and WGA). However, no signal was detected when using PNA. These results indicate the presence of multiple forms of glycosylated PRL in the anterior pituitary gland of Japanese quail.

Key Words: Prolactin, Quail, Isoform

M262 Developmental gene expression of preprocholecystokinin (CCK) in lines of chickens divergently selected for high or low juvenile body weight. J. C. Gould*, C. R. Miller, P. B. Siegel, and E. A. Wong, *Virginia Polytechnic Institute and State University*, *Blacksburg*.

This study was designed to measure developmental gene expression of preprocholecystokinin (CCK), a satiety inducing peptide, in the small intestine of chickens that have undergone long-term genetic selection for high (HWS) or low (LWS) 8-wk body weight. HWS chickens are hyperphagic, while LWS chickens are hypophagic. Chicks were reared in batteries with ad libitum access to feed and water. Chicks were weighed and killed on embryonic d 20 (e20), d of hatch (DOH with no access to feed), and d 3 (D3) and 7 (D7) post hatch. RNA was extracted from duodenum, jejunum, and ileum from four males from each line and time point. The abundance of CCK mRNA was assayed by real time PCR using the relative quantification method with GAPDH as the endogenous control. LWS males had a 2.4-fold higher CCK mRNA abundance than HWS males ($P = 0.009$), with abundance of CCK mRNA higher in the ileum ($P < 0.001$) than the duodenum and jejunum. There was an effect of age ($P = 0.037$) with gene expression of CCK increasing through D3 and decreasing slightly by D7. These results indicate that long term selection for high or low 8-wk body weight has affected gene expression of CCK in the small intestine of chickens. Higher expression of CCK in LWS males compared to HWS males suggests a role for CCK in the hypophagia observed in LWS chickens.

Key Words: Chicken, Small Intestine, Preprocholecystokinin

M263 Incremental dietary conjugated linoleic acid (CLA) mixture inclusion has non-linear effects on atherosclerosis in cholesterol-sensitive Japanese quail. C. K. Reynolds*, M. S. Lilburn,

S. G. Velleman, V. L. Cannon, J. A. Lynch, D. L. Hartzler, and W. L. Bacon, *The Ohio State University, OARDC*, *Wooster*.

Our objective was to determine the incremental effect of dietary CLA on the development of atherosclerosis in Japanese quail selected for cholesterol-induced aortal plaque deposition. At 19 wks of age 120 male quail were randomly assigned to one of 10 pens (12 birds/pen) and fed for ad libitum intake one of 5 diets (2 pens/diet). Diets were a negative control containing 1.25% soybean oil and no cholesterol and 4 diets containing 0.5% cholesterol and one of 4 levels of CLA oil (40% *cis*-9, *trans*-11 CLA, 40% *trans*-10, *cis*-12 CLA; replacing soybean oil) providing 0, 0.25, 0.5, or 1.0% CLA (DM basis). After 14 wks a jugular vein blood sample was taken and quail were euthanized. A score (0 to 4) was assigned for aortal lesions and samples were frozen for later analysis of plasma cholesterol and triglyceride (TAG) concentration and fatty acid concentrations in abdominal fat. Treatments had no effects on body wt (108 g) or plasma TAG, but liver wt was increased (linear, $P < 0.07$) by CLA (Table). Plasma cholesterol was increased ($P < 0.02$) by cholesterol and decreased (linear, $P < 0.07$) by CLA. Aortal lesions were increased by cholesterol ($P < 0.01$) and decreased by CLA (quadratic, $P < 0.02$), with the greatest reduction for 0.5% CLA. Feeding cholesterol increased C18:1 and C16:0 and decreased *cis*-9, *cis*-12 C18:2 and C18:3 concentrations in abdominal fat ($P < 0.05$). Abdominal fat concentrations of CLA, C16:0, and C18:0 were increased and concentrations of *cis*-9, *cis*-12 C18:2 and C18:3 were reduced (linear, $P < 0.01$) by dietary CLA. Consumption of a CLA mixture lessened the severity of cholesterol-induced atherosclerosis in Japanese quail, in part through reduced plasma cholesterol concentration. Reasons for the reduced response at the highest CLA inclusion level are not apparent, but differential effects of the individual isomers fed should be investigated.

Table 1.

Item	Control	0% CLA	0.25% CLA	0.5% CLA	1.0% CLA	SEM
Cholesterol, mg/dl	233	1364	1216	1108	1111	62
Triglyceride, mg/dl	151	335	342	475	312	58
Liver wt, g	1.86	2.35	2.60	2.81	2.79	0.14
Aorta score	1.16	3.75	3.49	2.77	3.56	0.20

Key Words: Atherosclerosis, Conjugated Linoleic Acid, Cholesterol

M264 Effects of feeding blends of grains naturally contaminated with Fusarium mycotoxins on small intestinal morphology of turkeys. C. K. Girish* and T. K. Smith, *University of Guelph*, *Guelph, Ontario, Canada*.

An experiment was conducted to investigate the effects of feeding turkeys grains naturally contaminated with Fusarium mycotoxins on morphometric indices of duodenum, jejunum and ileum, and the possible preventative effect of feeding a polymeric glucomannan mycotoxin adsorbent (GMA, Mycosorb®, Alltech, Inc., Nicholasville, KY). Three hundred 1-d-old male turkey poults were fed wheat, corn and soybean meal-based starter (0-3 wk), grower (4-6 wk), developer (7-9 wk), and finisher (10-12 wk) diets formulated with uncontaminated grains (C), contaminated grains (CONT) and contaminated grains + 0.2 % GMA (CONT+GMA). The morphometric indices were measured at the end of each growth phase and included villus height (VH), crypt depth (CD), villus width (VW), thicknesses of submucosa and muscularis, crypt to villus ratio and apparent villus surface area (AVSA). At the end of the starter phase, feeding CONT significantly (p=0.01) decreased the VH (968.44 vs 782.68µm) in duodenum and feeding CONT+GMA prevented this effect (782.68 vs 991.28µm) (p=0.002). The feeding of CONT also reduced VH (448 vs 380µm) (p=0.04) and AVSA (29944 vs 23604 µm2) (p=0.01) in jejunum, whereas none of the variables were affected in the ileum. VW (41.62 vs 36.23µm) (p=0.04) and AVSA (29342 vs 22057µm2) (p=0.03) of duodenum, VH (738.64 vs 582.27µm) (p=0.02) and AVSA (56346 vs 41129µm2) (p=0.01) of jejunum and submucosa thickness of ileum (31.94 vs 24.69 µm) (p=0.04) were significantly reduced when birds were fed CONT compared to C at the end of the grower phase and the feeding of CONT+GMA prevented ($p<0.05$) these effects in jejunum and ileum. The feeding of CONT did not significantly ($p>0.05$) affect the morphometric variables at the end of the developer and finisher phases. It was concluded that consumption of grains naturally contaminated with Fusarium mycotoxins results in adverse effects on intestinal morphology during the early growth phase of turkeys and GMA can prevent many of these effects.

Key Words: Fusarium mycotoxin, Duodenum, Jejunum

M265 Age-specific species variation in oxidative stress in birds. X. Guan*, K. Gyenai, C. Larson, and E. Smith, *Virginia Polytechnic Institute and State University*, *Blacksburg*.

Aging reduces the ability of livestock and poultry to sustain reproductive ability, especially egg-laying in birds. Delaying aging thus has economic benefits in poultry and other livestock species. Understanding the biochemical and molecular mechanisms that underlie the aging process could help develop approaches including selection that will slow the aging process in birds. Here, our objective was to test if birds with different longevities differ in oxidative stress levels associated with aging. The species evaluated were the 20 budgies, 15 guinea fowls, 30 Japanese quails and 30 domestic turkeys. Biomarkers used to estimate oxidative stress were thiobarbituric acid reacting substance (TBARS), an oxidant, and plasma uric acid (PUA) and glutathione (GSH), both antioxidants. Biomarkers were determined at 10, 30, 55 and 80 wks-of-age within each species. In the Guinea fowl, PUA (from 4.78 mg/dL to 8.28 mg/dL) and TBARS (0.22 to 0.57 mg/L) increased significantly with age while GSH (1074.43 to 613.63 uM) decreased significantly over the same period. Though changes in the levels of the biomarkers with age were inconsistent in the Japanese quail, the oxidant levels increased while the antioxidants decreased with age. In the turkey, PUA (6.85 to 4.69 mg/dL) decreased significantly from 10 to 55 wks-of-age while TBARS (0.31 to 0.56 mg/L) increased. In the budgie, antioxidant level decreased with age though not as rapidly as in the other species. Though changes in the oxidative stress were inconsistent and showed no clear pattern, it appears that the decline in oxidant and antioxidant status varies with species, suggesting a genetic basis to this biologically important characteristics.

Key Words: Oxidative Stress, Poultry, Biomarkers

M266 Effect of maternal stress on the stress hormone and growth response of pigs to a lipopolysaccharide (LPS) challenge. P. N. Williams*[1], J. A. Carroll[2], J. W. Dailey[2], and T. H. Welsh, Jr.[3], [1]*Texas A&M University-Kingsville*, *Kingville*, [2]*USDA-ARS, Livestock*

Issues Research Unit, *Lubbock, TX, USA*, [3]*Texas A&M University*, *College Station*.

This study assessed the effect of maternal stress on the stress hormone and growth response of the progeny following an endotoxin challenge. Sows were assigned to one of two treatments (n = 10 per treatment) and subjected to either a daily 5-min restraint stress (stressed; S) from d 84 to d 112 of gestation or managed per current industry standards (non-stressed; NS). All sows were then managed similarly through farrowing and lactation. At weaning (20.0 ± 0.3 d) pigs from S and NS sows (n = 40 per treatment balanced for litter and gender) were selected, transferred to a climate controlled facility where they were placed into individual pens and allowed ad libitum access to feed and water. Pigs were allowed to acclimate for 14 d before LPS challenge. On d 14 pigs were weighed and non-surgically fitted with jugular catheters. On d 15 pigs were infused i.v. with LPS (25 µg/kg BW) and blood samples collected every 30 min for 1 h prior to and 6 h following LPS challenge. Serum was analyzed for cortisol (CS), norepinephrine (NE), and epinephrine (E). Weekly weights were taken and average daily gain (ADG) prior to and following LPS challenge calculated. Baseline (pre-LPS) CS, E, and NE were not affected ($P > 0.05$) by maternal treatment. Consistent with previous reports, CS, E and NE increased ($P < 0.01$) in a time-dependent manner following LPS with peak values at 3, 1 and 0.5 h post-infusion. Although not affecting the temporal pattern, S pigs had a decreased ($P < 0.01$) CS response and tended ($P = 0.07$) to have a greater E response following LPS. Furthermore, there was a tendency ($P = 0.08$) for S pigs to have greater NE then NS pigs post-LPS. Maternal treatment did not affect ($P > 0.40$) ADG prior to or following LPS challenge. However, there was a positive relationship between ADG prior to the LPS challenge and peak NE following LPS ($r = 0.29$; $P<0.01$) and a negative relationship between peak E and ADG following LPS ($r = -0.23$; $P<0.05$). Collectively, these results indicate that maternal stress alters the stress hormone response of the progeny to an endotoxin challenge.

Key Words: Maternal Stress, LPS, Pig

M267 Expression of porcine intestinal alkaline phosphatase during the early postnatal development. T. Li[1,2], C. Yang[2], D. Lackeyram[2], Y. L. Yin[1], C. F. M. de Lange[2], and M. Z. Fan*[2], [1]*The Chinese Academy of Sciences*, *Changsha, Hunan, China*, [2]*University of Guelph*, *Guelph, Ontario, Canada*.

The small intestinal alkaline phosphatase (IAP) is responsible for hydrolyzing phosphoric ester bonds of organic phosphorus compounds and plays a role in absorption of triglycerides. To understand factors affecting early postnatal IAP expression, we examined IAP hydrolytic kinetics (Vmax, Km), digestive capacity (Vcap), jejunal IAP protein and mRNA abundances and their associations with hormonal factors in 36 ad libitum fed pigs. Six pigs were sacrificed at 1, 4, 6, 12, 20 and 28 d of age, respectively. Vmax was significantly high in jejunum and low in duodenum and distal ileum for all the age groups. Km was significantly high in jejunum, intermediate in the duodenum and low in distal ileum for all the age groups. There were postnatal decreases ($P<0.05$) in Vmax for all the small intestinal segments and Vcap, while significant changes in Km were only observed in jejunum. Pearson analysis showed that Vcap was correlated ($P<0.05$; $r=0.62$ and 0.64) with jejunal Vmax, however, poorly related ($P=0.13$; $r=0.27$) to duodenal Vmax. There were up to the quartic pattern of age effects ($P<0.05$) on the proximal jejunal homogenate and apical membrane IAP protein abundances, while a quadratic age effect was observed ($P<0.05$) in the proximal jejunal IAP relative mRNA abundance measured by real time RT-PCR. Jejunal IAP Vmax was correlated ($P<0.05$; $r=0.59$-0.65) with IAP protein abundance, however, poorly related ($P=0.66$; $r=0.08$) to IAP mRNA abundance. Furthermore, jejunal homogenate and apical IAP protein abundances were poorly correlated ($P=0.91$ or 0.73; $r=-0.02$ and -0.06) with IAP mRNA abundance. In conclusion, there were dramatic reductions in IAP maximal activity and digestive capacity during early postnatal development in the pig, likely regulated at the levels of post-transcriptional IAP protein processing and post-translational IAP affinity modifications.

Key Words: Gene Expression, Intestinal Alkaline Phosphatase, Pigs

M268 Changes of physiological and biochemical parameters in weaned pigs. X. F. Kong*[1], Y. L. Yin[1], F. G. Yin[1], H. J. Liu[1], F. F. Xing[1], Q. H. He[1], T. J. Li[1], R. L. Huang[1], P. Zhang[1], M. Z. Fan[2], S. W. Kim[3,4], and G. Y. Wu[1,4], [1]*The Chinese Academy of Sciences*, *Changsha, Hunan, China*, [2]*University of Guelph*, *Guelph, Ontario, Canada*, [3]*Texas Tech University*, *Lubbock*, [4]*Texas A&M University*, *College Station*.

This study was conducted to determine the values of serum biochemical parameters in piglets weaned at 21 d of age. On d 0, 7, 14 and 28 post weaning, venous blood samples were obtained randomly from 5five piglets for analysis. With increasing age, the numbers of leukocytes, lymphocytes and granulocytes increased ($P < 0.05$) progressively. The erythrocyte volume, the platelet distributing width, serum concentrations of phosphorus, urea, total cholesterol and glucose, as well as serum activities of lipase, creatine phosphokinase and glutamate-pyruvate transaminase decreased ($P < 0.05$) on d 7 and increased ($P < 0.05$) thereafter. Serum activity of alkaline phosphatase increased ($P < 0.05$) progressively between d 0 and 14 post weaning and declined thereafter ($P < 0.05$). Concentrations of erythrocyte hemoglobins increased ($P < 0.05$) progressively between d 0 and 14, and the elevated values remained until d 28. In contrast, serum concentrations of ammonia, Zn, Na and Cl increased ($P < 0.05$) on d 7 and decreased ($P < 0.05$) thereafter. Serum concentrations of triglycerides on d 14 and 28 were lower ($P < 0.05$) than those on d 0 and 7. Serum concentrations of all amino acids, except for glutamate, glutamine, ornithine, citrulline and arginine, increased ($P < 0.05$) on d 7 and decreased ($P < 0.05$) thereafter. The ratio of kidney weight to BW decreased ($P < 0.05$) progressively until d 28, the ratios of stomach, lymph nodes, and liver weights to BW were the highest ($P < 0.05$) on d 7, and the ratio of spleen weight to BW was the highest ($P < 0.05$) on d 14. These results indicate that serum metabolite concentrations and organ growth undergo marked changes in post-weaning piglets. (Supported by NSFC and CAS)

Key Words: Weaned Pigs, Serum Parameters, Growth

M269 Omega-3-fatty acid supplementation and the IGF system in early pregnancy in pigs. A. Brazle*, T. Rathbun, B. Johnson, and D. Davis, *Kansas State University*, *Manhattan*.

The IGF system of growth factors, receptors and binding proteins functions from early in pregnancy. Recent evidence indicates improved embryo survival in gilts fed supplemental omega-3 fatty acids

beginning before conception. Here we report effects of supplementing a corn-soybean meal diet (Control) with a marine source of protected omega-3 fatty acids (PFA, 1.5% of diet) on mRNA expression for IGF-I, IGF-II, IGFBP-3 and IGFBP-5 in the porcine gravid uterus. The PFA (Fertilium™365) contained equal amounts of eicosapentanoic (EPA) and docosahexanoic (DHA) acids and replaced corn in the diet beginning when gilts were approximately 170 d old (n=13/treatment). Gilts were artificially inseminated at approximately 205 d of age. Conceptus and endometrial samples were collected at d 11, 15, and 19 of gestation. All gilts were pregnant. In the conceptus, message for IGF-II and IGFBP-3 increased ($P < 0.001$) from d 15 to d 19 while there was an increase ($P < 0.001$) in IGF-I and IGFBP-5 from d11 to 15 and a decrease ($P < 0.001$) to d 19. In the endometrium, message for IGF-I was stable over the interval but message for IGF-II and IGFBP-5 were increased by d 15 and IGFBP-3 by d 19 ($P < 0.01$). There were trends for omega-3-fatty acid supplementation to increase endometrial IGF-II ($P = 0.09$) and IGFBP-5 ($P = 0.12$) on d 15. In the d-19 conceptus, embryonic but not extraembryonic IGF-I mRNA tended ($P = 0.13$) to be greater for PFA compared to Control gilts. During d 11 to 19 the conceptus is elongating, attaching to the uterus, and the embryonic disc is differentiating from a homogenous tissue to form the tissues and organs of the adult. One mechanism for omega-3 fatty acid effects in early pregnancy could involve epigenetic effects on mRNA expression for the IGF and IGFBP proteins.

Key Words: Pig, IGF, Omega-3 Fatty Acids

M270 Serum and anterior pituitary (AP) concentrations of IGF-I and relative amounts of AP IGF binding proteins throughout the estrous cycle in gilts. A. R. Taylor* and J. A. Clapper, *South Dakota State University*, *Brookings*.

It has been established that components of the circulating and anterior pituitary IGF system vary in response to steroids in the pig. However, whether serum and anterior pituitary concentrations of the IGF system vary throughout the estrous cycle has not been determined. To further examine this relationship the following experiment was performed. Forty gilts of similar age and weight (180 d; 120 kg) were injected with PG 600 to induce the gilts into puberty. Fifteen days later all gilts were fed 15 mg Matrix for 15 d to synchronize estrus. Gilts were checked twice daily for expression of estrus beginning 3 d after the end of Matrix treatment and continuing for 7 d. The first day each gilt exhibited estrus was designated as d 1 of the estrous cycle. Blood samples were obtained by jugular venipuncture on d 1, 4, 7, 10, 13, 16, 19, and 22 of the estrous cycle. On d 7, 13, 19, and 22 of the estrous cycle 10 pigs were killed and anterior pituitary glands (AP) were collected. Serum concentrations of IGF-I and AP concentrations of IGF-I were determined by RIA. Relative amounts of AP IGF-binding proteins (IGFBP) were determined by Western ligand blot analysis. Serum concentrations of IGF-I fluctuated throughout the estrous cycle. Mean serum concentrations of IGF-I decreased ($P<0.02$) from d 1 through d 10, then increased ($P<0.02$) on d 13 through 16, then decreased ($P<0.02$) from d 19 through 22. Mean AP concentrations of IGF-I were greater ($P<0.03$) on d 19 compared to all other days, while no difference was detected ($P>0.05$) in mean anterior pituitary concentrations of IGF-I on d 7, 13, and 22. Western ligand blot analysis identified 33 kDa IGFBP-2 and 29 kDa IGFBP-5 in the AP. Mean relative amounts of AP IGFBP-2 and -5 were each greater ($P<0.02$) in gilts on d 19 compared to all other days while no difference was detected in mean relative amounts of AP IGFBP-2 and -5 among pigs on d 7, 13, and 22 of the estrous cycle. Anterior pituitary gland function in the pig may be influenced by the IGF system during the estrous cycle.

Key Words: Pig, Estrous Cycle, IGF

M271 Growth performance and muscle protein, RNA and DNA content in juveniles of *Pseudoplatystoma fasciatum* (Teleostei, Pimelodidae) fed lyophilized bovine colostrum. P. Pauletti, L. Kindlein, A. R. Bagaldo, A. P. O. Rodrigues, E. F. Delgado, J. E. P. Cyrino, and R. Machado-Neto*, *Escola Superior de Agricultura "Luiz de Queiroz" – ESALQ/USP*, *Piracicaba, SP, Brazil*.

Little information is available on the physiology and growth performance of speckled catfish, *Pseudoplatystoma fasciatum*, an important Brazilian freshwater food-fish. Muscle DNA, RNA, total protein (TP) contents and RNA:DNA ratios are good indexes of fish growth and condition. The IGF-I plays a central role in the growth regulation system, and the defatted lyophilized bovine colostrum (BC) is a rich source of IGF-I. The objective of this study was to evaluate effects of diets with partial replacement of protein source by BC on growth performance, body composition, and muscle TP, RNA, and DNA contents of juvenile speckled catfish (35.14 ± 2.23^{-1}) fed ad libitum for 30 or 60 days with five diets (45% crude protein; 4000 kcal kg^{-1}) with increasing levels of BC (0, 5, 10, 15 and 20%) (n=3). BC positively influenced weight gain, specific growth rate, and feed conversion only at 30 d. Carcass lipid contents were higher above 10% dietary BC levels. DNA concentration increased ($P\leq0.05$) between 30 and 60 d; all levels of BC elicited higher DNA concentration at 60 d, except for diets 5 and 10% BC, while the RNA concentration decreased ($P\leq0.05$). Higher ($P\leq0.05$) TP concentrations were registered at 30 d when dietary BC levels were 15 and 20%. At 60 d, diets 0, 5, 10 and 20% BC induced reduction of RNA:DNA ratio comparatively to 30 d ($P\leq0.05$). Increased DNA muscle content indicate that fish fed diets containing BC present additional hyperplasic growth.

Key Words: Siluriformes, Biochemical Indicators, Growth

M272 Feeding juveniles of *Pseudoplatystoma fasciatum* (Teleostei, Pimelodidae) with lyophilized bovine colostrum: Growth and protein, RNA and DNA content in liver and intestine. P. Pauletti, L. Kindlein, A. R. Bagaldo, A. P. O. Rodrigues, E. F. Delgado, J. E. P. Cyrino, and R. Machado-Neto*, *Escola Superior de Agricultura "Luiz de Queiroz" – ESALQ/USP*, *Piracicaba, SP, Brazil*.

The knowledge about the physiology and growth performance of speckled catfish, *Pseudoplatystoma fasciatum*, is strategic to the Brazilian freshwater food-fish industry. Concentrations of DNA, RNA and total protein (TP) in body tissues provide reliable indicators of feeding regime changes. The contribution of visceral tissues, namely liver and gut, to whole-body energy expenditures is related to protein synthetic activity. The liver plays an important role in the regulation of fish energy metabolism and growth, and IGF-I plays vital role in growth regulation and tissues differentiation. The defatted lyophilized bovine colostrum (BC) is a rich source of growth factors, such as IGF-I. The objective of this study was to evaluate effects of diets with partial replacement of protein source by BC on growth and TP, RNA and DNA contents in liver and intestine of juvenile speckled catfish ($35.14 \pm 2.23\ g^{-1}$) fed ad libitum for 30 or 60 days with five diets (45%

crude protein; 4000 kcal kg^{-1}) with increasing levels of BC (0, 5, 10, 15 and 20%) (n=3). Liver and intestine DNA concentrations increased (P≤0.05) between d 30 and 60 indicating a hyperplasia process, but no significant differences (P≥0.05) for RNA concentration in the same period were registered. Liver TP did not differ (P≥0.05) between diets, but decreased (P≤0.05) with time; significant effect of diet and period was observed for intestinal parameters, BC 5% being superior to others diets. Intestine TP decreased (P≤0.05) between d 30 and 60. Diets did not influence RNA/DNA rations in both liver and intestine, but decreased (P≤0.05) markedly between 30 and 60 d. Liver and intestine growth was characterized by a major contribution of hyperplasia compared to hypertrophy, as confirmed by linear increases in total DNA and a decrease in RNA/DNA and protein:DNA ratio.

Key Words: Siluriformes, Visceral Tissues, Nucleic Acids

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M273 Effect of ProAgri™ amendment, before and after cleanout, on broiler litter moisture, calcium, nitrogen, and total and soluble phosphorus. N. G. Zimmermann*[1], R. Angel[1], and W. Saylor[2], [1]*University of Maryland*, *College Park*, [2]*University of Delaware*, *Newark*.

Nutrient pollution is a serious problem whenever animal production is concentrated and too little land is available for manure application. A 60 pen broiler experiment was conducted where diet and litter management were used concurrently to reduce nutrient pollution. A single flock (Ross 308) was grown on fresh pine shavings. The experiment was a 3 × 2 × 2 factorial design with unequal replication. Main effects were sex, feeding regimen, and litter amendment. The sex main effect was female, male, or straight run; number of birds per 1.52 × 2.44 m pen was 55, 45, and 50, respectively. Four and six phase diets were the feeding regimen main effect. The litter amendment main effect was ProAgri™ Activator followed by ProAgri™ 8-26-2 sodium silicate solutions sprayed onto litter (2.54 and 0.76 l/m^2, respectively). Total number of birds was 2880. At the end of the trial samples of litter from each pen, including cake, were collected to measure percent moisture, available water (A_w), N, Ca and total (tP) and soluble P (sP). Furthermore, a subsample of litter was treated with ProAgri™ Activator solution, 1:1(w:v) then ProAgri™ 8-26-2 sodium silicate solution, 2.4:1 (w:v). After oven drying, N, Ca, and tP and sP were measured. Only the effects of the litter amendment are reported here except for main effect interactions. Application of the litter amendment prior to bird placement did not have an effect on percent moisture, A_w, N, Ca, tP, or sP in clean out litter. However, clean out litter treated with the amendment had reduced (P>.05) sP (486 vs 271 mg/g) and N. Furthermore, a significant interaction of litter amendment with diet regimen was observed. The litter amendment reduced (P>.05) sP in litter when diets containing higher levels of tP were fed.

Key Words: Litter Amendment, Phosphorus, Nitrogen

M274 Genotype analysis of *Campylobacter* spp. isolated from various internal organs and unabsorbed yolks of commercial broiler and roaster chickens. K. L. Hiett, R. J. Buhr*, N. A. Cox, L. J. Richardson, P. J. Fedorka-Cray, J. S. Bailey, and J. K. Northcutt, *USDA-ARS, Russell Research Center*, *Athens, GA*.

Campylobacter spp. are presently believed to be the leading bacterial etiological agent of acute gastroenteritis in the human population. Evidence implicates poultry as a significant source of the organism for human illness; however, the pathways involved in *Campylobacter* spp. contamination of poultry flocks remain unclear. In an effort to further understand the dissemination of naturally occurring *Campylobacter* spp. through commercial broiler and roaster chickens, *Campylobacter jejuni* isolates previously recovered from the liver/gallbladder, spleen, ceca, and unabsorbed yolks of broiler and roaster chickens were genotyped using *flagellinA* Short Variable Region (*flaA*-SVR) DNA sequence analysis. All isolates recovered from broilers were of one *flaA*-SVR subtype regardless of the site of recovery. Isolates recovered from roasters comprised two subtypes. The predominant subtype (*flaA*-SVR type 1) contained isolates recovered from all locations tested. Additionally, this same *flaA*-SVR subtype was recovered from both broilers and roasters. This investigation demonstrated that very closely related subtypes of *C. jejuni* were naturally present within the internal organs and unabsorbed yolks of commercial broilers and roasters from different flocks, companies, and breeder strains. Further investigations of these subtypes are needed to understand their involvement in intestinal tract microbiology and the subsequent contamination of the final food product.

Key Words: *Campylobacter*, Genotyping, Tissues

M275 Recovery of naturally occurring *Campylobacter* from the circulating blood of market age commercial broilers. L. J. Richardson[1], N. A. Cox[1], R. J. Buhr*[1], and M. A. Harrison[2], [1]*USDA-ARS-PMSRU, Russell Research Center*, *Athens, GA*, [2]*Department of Food Science and Technology, University of Georgia*, *Athens*.

Campylobacter species have recently been recovered from several primary and secondary lymphoid tissues and internally from the spleen of poultry. The objective of this study was to determine whether naturally occurring *Campylobacter* can be recovered from the circulating blood of market age commercial broilers utilizing aseptic techniques. Broilers (n=100) were acquired from two commercial processing facility's live haul area on 10 separate days. The feathers where removed from the ventral surface of the humerous and alcohol was sprayed on the skin, then Betadine was applied to the area and allowed to sit for 1 min before vena-puncture (brachial vein) with a sterile needle. Five mL of circulating blood was collected and added to 45 mL of Bolton's broth without antibiotics and incubated at 42 C in microareophilic conditions for 48 h and then streaked onto Campy-Cefex plates. For flocks 9 and 10, direct plating onto aerobic plate count agar was also performed to verify that the skin had been disinfected. Standard laboratory procedures for *Campylobacter* were performed on ceca contents collected from all broilers sampled. *Campylobacter* were not recovered from the blood (0/60) nor the ceca (0/60) from flocks 1-4, 6, or 7. From flocks 5 and 8-10, *Campylobacter* were recovered from the blood (11/40) and the ceca (28/40). From aerobic plate counts performed in flocks 9 and 10, no growth was observed suggesting that the method utilized results in aseptic sampling of the circulating blood. With *Campylobacter* being recovered from the circulating blood, this provides insight to a possible means by which this organism is able to rapidly disseminate to tissues within the bird and suggests that *Campylobacter* is not strictly limited to the

digestive tract. Further research will determine whether *Campylobacter* resides in the blood for prolonged periods of time or if the organism's presence is merely transitory.

Key Words: *Campylobacter*, Blood, Broilers

M276 Effect of a *Lactobacillus spp*-based probiotic culture product on broiler chick performance under commercial conditions. A. D. Wolfenden*[1], J. L. Vicente[1,2], L. Aviña[2], A. Torres-Rodriguez[3], G. Tellez[1], and B. M. Hargis[1], [1]*University of Arkansas*, *Fayetteville*, [2]*Sigrah Zellet de Mexico S.A. de C.V.*, *Cuernavaca Morelos, Mexico*, [3]*Cobb-Vantress*, *Siloam Springs, AR*.

Concern about antimicrobial resistance has led to increased attention to alternatives for controlling infections and increasing performance in animal production. Probiotics and organic acids have gained attention as options in poultry industry. Our laboratory has been working in the selection of lactic acid bacteria, mainly from the genus *Lactobacillus*, as potential probiotic candidates. Previous data indicates that these selected probiotic bacteria are able to reduce *Salmonella* infection and improve performance in broiler and turkey under experimental and commercial trials in the USA. The selected probiotic organisms were used in field trials to evaluate their efficacy in commercial conditions in Mexico. In the present report, the probiotic culture (n= 6 broiler houses) significantly reduced mortality (P<0.01) compared to 6 control houses (5.87% vs. 6.72%). Also, a consistent, albeit non-significant, improvement of body weight, 2.06% (Control: 2.429 ± 0.157kg vs. Treated: 2.479 ± 0.164kg) and reduction of FCR (3.5%) was observed in the treated flocks. Average daily gain was improved by 1.8% in the treated flocks (50.4 ± 1.98g) compared to the control (49.5 ± 1.88g) with p=0.06. The results of this report suggest that this *Lactobacillus*-based probiotic culture could be useful to reduce mortality and improve performance in commercial poultry farms.

Key Words: *Lactobacillus*, Broiler, Performance

M277 Factors affecting the eggshell thickness on laying hens in Tepatitlan, Jalisco. R. G. Ramírez*, A. J. Zárate, M. G. Alcorta, and J. A. C. Meneses, *Universidad Autónoma Chapingo*, *Texcoco, Estado de México, México*.

The eggshell quality is a very important trait in laying hens, due to the losses by broken eggs. The objectives of this research were to evaluate genetic and environmental factors affecting eggshell quality in Leghorn type hens in the Tepatitlan, Jalisco area, and to determine the relationship between Eggshell Thickness (ET) and Eggshell Stiffness (ES). A total of 6,157 eggs of 24 poultry farms were sampled and their eggshell thickness and eggshell stiffness values were measured. The Laying Strain (LS), Laying Age (LA) and Feed Type (FT) were registered for each egg measured. Data analysis included a linear correlation (ET-ES), regression for ET (n=2626) and ES (n=6151) with LA as a covariate of LS, and means tests to determine differences among LS, LA and FT on their ET and ES values. There were differences within Laying strains and Feed Types (P<0.05) for both, ET and ES. Linear correlation coefficient between ET and ES was 0.67 in this research. Means and standard deviation for ET and ES was 0.324 ± 0.0308 mm and 3481 ± 850.9 g/cm2 respectively.

Key Words: Eggshell Quality, Strain, Feed

M278 Effects of feeding blends of grains naturally contaminated with Fusarium mycotoxins on performance, hematology and blood chemistry of turkeys. C. K. Girish*, T. K. Smith, H. J. Boermans, and N. A. Karrow, *University of Guelph*, *Guelph, Ontario, Canada*.

An experiment was conducted to investigate the effects of feeding blends of grains naturally contaminated with Fusarium mycotoxins on performance, hematology and blood chemistry of turkeys. The efficacy of polymeric glucomannan mycotoxin adsorbent (GMA, Mycosorb®, Alltech, Inc., Nicholasville, KY) in preventing the adverse effects of Fusarium mycotoxins was also evaluated. Three hundred 1-d-old male turkey poults were fed wheat, corn and soybean meal-based starter (0-3 wk), grower (4-6 wk), developer (7-9 wk), and finisher (10-12 wk) diets formulated with uncontaminated grains, contaminated grains and contaminated grains + 0.2 % GMA. Feeding contaminated grains to turkeys significantly decreased body weight gains during the grower and developer phases. Feeding contaminated grains did not, however, alter feed intake or feed efficiency. GMA supplementation prevented the effects of contaminated grains. The feeding of contaminated grains reduced (p<0.05) total lymphocyte counts at wk 3. Supplementation with GMA increased plasma total protein concentrations compared to controls and birds fed the contaminated diet. Plasma uric acid concentrations in birds fed contaminated grains were increased at the end of the experiment compared to controls and the feeding of GMA prevented this effect. The feeding of contaminated grains for 12 wk increased the relative weights of gizzard and bursa of Fabricius. Dietary supplementation with GMA in contaminated diet prevented the effects on the bursa of Fabricius. It was concluded that turkey performance, some blood parameters and organ weights were affected by feed borne Fusarium mycotoxins, and that GMA prevented many of these effects.

Key Words: Fusarium Mycotoxin, Performance, Hematology

M279 Impacts of raising season and phytase addition to standard and vegetable diets on broilers performance and litter physical characteristics. N. Bergeron*[1], A. Ouyed[2], and M. Lefrançois[1], [1]*Université Laval*, *Québec, Québec, Canada*, [2]*Centre de recherche en sciences animales de Deschambault*, *Deschambault, Québec, Canada*.

Two experiments were conducted in summer and winter, respectively, to assess the effects of phytase (PHY) addition to conventional (CON) and all vegetable (VG) diets on broilers performance and litter physical characteristics as dry matter content. To this end, 3080 Ross × Ross male broilers were allotted to 40 pens in each assay, according to a complete randomized block design with diets (CON vs VG) and PHY (0 vs 100 g/t liquid Natuphos 5000™) as main factors. CON diets contained animal fat (Sani-Santé™) and meat meal (54.35% CP) which were replaced with micronized soybean in the VG diets. Broilers were submitted to a four phases feeding program respecting the following nutritional specifications for CP (%), ME (kcal/kg), aP (%) and Ca (%) : starter from 0-15 d (21.9; 3039; 0.45; 0.96), grower from 16-21 d (19.9; 3139; 0.40; 0.85), finisher 1 from 22-32 d (17.9; 3193; 0.37; 0.80), and finisher 2 from 33-38 d (16.9; 3216; 0.32; 0.71). Broilers fed the CON diets had greater final body weights when results from both assays were combined (2905 vs 2853 g; P<.01), whereas PHY addition had no effects (2883 vs 2875 g with PHY). Overall feed efficiency (FE) was improved (1.667 vs 1.615; P<.0001) when broilers were fed the VG diets. PHY addition had no effects on FE (1.642 vs 1.641 with PHY). FE was also better (P<.05) in winter (1.631) than

in summer (1.651). Apparent litter density (kg/m^3) was not influenced (P>.05) by the dietary treatments (CON/-PHY:350.38; CON/+PHY: 350.24; VG/-PHY: 360.11; VG/+PHY:353.80) but increased (P<.0001) in winter (375.56 vs 331.70). In summer, litter dry matter content was higher with CON diets (70.06 vs 64.14% ; P<.0001) and without added PHY (68.67 vs 65.44% ; P<.01). CON fed broilers showed better feed efficiency and final body weight than VG fed broilers. VG fed broilers produced a more humid litter in summer only. PHY addition increased litter moisture but did not influence broilers performance. These results suggest that VG diets and dietary phytase addition had significant but limited negative impacts on broilers performance and litter characteristics.

Key Words: Broiler Performance, Phytase Vegetable, Litter

M280 Reduction of emissions from in vitro swine manure using monensin. T. R. Whitehead* and M. A. Cotta, *USDA-ARS-NCAUR, Peoria, IL*.

Storage of swine manure is associated with the generation of malodorous compounds and emissions. These are produced as a result of anaerobic degradation of materials present in manure and include sulfides, methane, organic acids, ammonia, and other volatile compounds. Because odor emission from livestock creates a nuisance and may be regulated, there is considerable interest in devising methods to control these emissions. Previous research in our laboratories has demonstrated that the primary microbial populations in stored swine manure are low (G+C), Gram positive anaerobic bacteria. One approach for reducing emissions production would be to target these populations. Monensin has been used to alter the bacterial population and metabolic end products in the rumen of domestic animals for improved animal performance, largely through its effect on Gram positive bacteria. Therefore, it was decided to test the effects of monensin on stored swine manure. Fecal and manure pit slurry were collected from a local swine production facility. Manure slurry (20% final concentration) was combined with 20% (w/v) feces and buffer and mixed under gas. The mixture was aliquoted into glass bottles under gas. Monensin (10 mM) was added to three bottles, and three bottles without monensin were used as controls. Gas production was measured over time, and aliquots were removed for chemical analyses and determination of viable bacterial numbers. Gas production in the monensin samples was greatly reduced within 24 hr (<10% of controls), and this reduction was maintained over a 28 day test period. Methane production was also reduced (<5% of controls). However, no detectable hydrogen was observed in any sample. Volatile fatty acid production was only slightly decreased in the monensin samples, while butyrate production increased 3 fold. These results are quite different from those observed in the rumen. The results of this study suggest that addition of antimicrobial compounds may prove useful for reducing gaseous, odorous emissions from swine facilities. Evaluation of other microbial inhibitors in addition to monensin appears warranted.

Key Words: Swine, Odor, Manure

M281 The relationship of animal, production, and carcass traits to consumer acceptability of grass-fed steaks. E. L. Steinberg*, J. W. Comerford, and V. H. Baumer, *The Pennsylvania State University, University Park*.

Twenty grass-fed steers and 10 grass-fed heifers were evaluated for the relationship of wintering growth rate, grazing daily weight gain, sex, grazing period, frame size, final weight, and carcass traits (fat thickness, ribeye area, marbling score, yield grade and shear force) to consumer evaluation of tenderness, juiciness, flavor, and acceptability of cooked steaks. All of the cattle were wintered for a targeted weight gain of 0.73 kg/d for 156 d, and then were grazed in rotationally-grazed paddocks containing primarily cool-season grasses. Cattle were harvested at a constant age (532.9 d ± 5.7 d) in 6 harvest groups ranging from 124 d to 187 d of grazing and carcass data were collected. Final quality grade ranged from low Select to low Choice. Longissimus muscle steaks were thawed, cooked, and offered to trained panelists. Steaks were evaluated for Warner-Bratzler shear force, and analysis of covariance evaluated the relationship of carcass traits with growth and animal traits, and consumer evaluations were compared with all traits. There was a significant covariance of yield grade with frame size and with fat thickness and grazing days ($P < 0.05$). Animal, growth, and carcass traits were not related to panelist evaluations of tenderness, flavor, juiciness, meat texture, or overall desirability for grass-fed cattle harvested at 532 d of age ($P > 0.05$). The relationship of marbling score and consumer evaluation of juiciness was not significant ($P = 0.21$). There was no significant covariance among frame size, juiciness, flavor, tenderness, texture or overall acceptability ($P > 0.05$) except for yield grade with juiciness ($P = 0.01$). Mean panel scores for grass-fed steaks were moderate for overall acceptability (4.6 out of 9), flavor (5.1 out of 9), and juiciness (3.1 out of 7), while scoring them slightly tough (4.4 out of 9). Significant variation in scores for tenderness, juiciness, flavor, and overall acceptability were found, indicating post-harvest interventions may be more effective in increasing consistency for consumers of grass-fed meat compared to production and carcass traits.

Key Words: Grass-Fed Beef, Carcass, Production

M282 Differentiation of fecal alkane and fatty alcohol markers of diet composition of cattle and sheep grazing a complex heathland sward. J. M. Moorby*, M. D. Fraser, V. J. Theobald, and S. M. Morris, *Institute of Grassland and Environmental Research, Aberystwyth, UK*.

To investigate inter- and intra-species differences in foraging strategy, two breeds of each of cattle (Welsh Black, WB, and a continental crossbreed, CX) and sheep (Welsh Mountain, WM and Scottish Blackface, SB) were rotationally grazed on four adjacent 1 ha plots of a *Calluna vulgaris*-dominated heathland community. In each of two sampling sessions in 2005, late July and late September, after adaptation for 21 d, fecal samples were collected from each animal and bulked over 7 d. These were dried and analyzed for alkane and long-chain fatty alcohol (LCFA) concentrations, which are of plant (diet) origin and are largely undigested. Their profiles in plants differ between species and thus their profiles in feces depend on diet composition. Data were analyzed by principal components (PC) analysis and hierarchical cluster analysis. A scatter plot of PC1 v. PC2 showed differentiation between cattle and sheep and within-species segregation of the sampling sessions, indicating different diets for cattle and sheep. This also indicated that diets differed by session, or at least that the marker profiles differed within the diets in different sessions. Analysis of variance of PC1 (accounting for 90.6% of data variation) with species, breed and month as treatment factors were significant ($P < 0.001$) for each factor. Similarly, HCA showed clear

clustering of species and sample months, with some overlap of breed within sample month. There was greater spread (PC variation and HCA heterogeneity) among the sheep data (SD of PC1 = 1451 for all sheep data, 1423 for WM, and 1258 for SB) than among the cattle data (SD of PC1 = 415 for all cattle data, 553 for WB, and 229 for CX). This indicates that cattle, and in particular CX, chose more consistent diets than sheep and perhaps while the cattle consumed diets dependant on plant availability, different breeds of sheep chose more varied diets. In conclusion, this work found greater variation in diet composition of sheep than of cattle given equal selection opportunities, and that diets differed in their alkane and LFCA concentrations at different times of the year.

Key Words: Grazing, Diet Selection, Alkanes

M283 Predicting the retention of ruminal boluses for the electronic identification of goats. S. Carné*, G. Caja, J. J. Ghirardi, and A. A. K. Salama, *Universitat Autònoma de Barcelona*, *Bellaterra, Spain*.

A total of 1,725 boluses were used to build-up a model for predicting the long-term retention of boluses into the forestomachs of adult goats under on-farm conditions. Animals belonged to Murciano-Granadina (dairy) and Blanca de Rasquera (meat) Spanish autochthonous goat breeds. Boluses consisted of 15 capsules made of different materials (ceramic, concrete, plastic with or without metallic balast) for achieving a wide range of physical features: length (37 to 84 mm), o. d. (9 to 22 mm), weight (5 to 110 g), volume (2.6 to 26 mL) and specific gravity (1 to 4.3). Each bolus contained an ISO half-duplex glass encapsulated transponder (32 × 3.8 mm). Boluses were administered by trained operators using adapted balling guns. Full-ISO handheld transceivers working at a frequency of 134.2 kHz were used to perform static readings. When a bolus loss (bolus not readable) was detected, a heavier bolus was applied. Retention rate (RR = 100 × read/applied) was calculated from data recorded from 2 to 24 mo post-application. No application problems or apparent behaviour alterations were observed for any bolus type. Bolus RR ranged 0 to 100% depending on their physical features. Only the largest bolus (26 ml; 110 g; and SG = 4.23) showed RR > 99%. Data allowed fitting a logistic model for predicting bolus retention from their volume (V, ml) and weight (W, g). The model (R^2 = 0.956; P < 0.001) was: RR (%) = 100 / (1 + 0.8086 e $^{0.879\ V\ -\ 0.283\ W}$). An exponential relationship (r = –0.84; P < 0.01) was found between specific gravity and W for the predicted values of bolus retention. Estimated weight and specific gravity for producing a standard size bolus (22 mL) with RR > 99% are greater than 95 g and 4.32, respectively. Further research is required for improving prediction accuracy.

Key Words: Electronic Bolus, Electronic Identification, Goat

M284 Effects of age and rearing method on long-term retention of different electronic identification devices in goat. S. Carné*, G. Caja, J. J. Ghirardi, and A. A. K. Salama, *Universitat Autònoma de Barcelona*, *Bellaterra, Spain*.

A total of 70 Murciano-Granadina kids were used for evaluating the use of visual ear tags and 3 types of electronic identification (ID) devices (injectable, ear tag and bolus) in replacement goats. Kids were ID after birth with 2 types of plastic ear tags (V1, n = 42; V2 = 25) in the left ear, and raised as a single group with ad libitum milk substitute, concentrate and straw until 60 d of age (7.7 ± 0.8 kg BW). Four kids (5.7%) died during this period. Half of the kids (n = 33) were weaned and a daily single milk feeding was maintained thereafter in the other half (n = 33) up to 5 mo of age. Kids were also ID at d 60 with 1 electronic ear-tag in the right ear (ET, n = 66; half-duplex double button tag, 6 g) and 1 electronic mini-bolus (B1,13.7 g, 51 × 11 mm, n = 66; half-duplex) containing a 32 × 3.8 mm half-duplex transponder. Additionally, kids were ID at d 90 with 2 injectable transponders in each metacarpus (IM1, 12 × 2.1 mm, n = 50; IM2, 15 × 2.1 mm, n = 75; full-duplex B glass encapsulated). Lost B1were replaced by larger bolus (B2, 20.1 g, 56 × 11 mm). Retention rate (read/applied × 100) of ID devices was recorded weekly up to18 mo of age. Intermediary retention at mo 5 varied between devices (V1, 85.4%; V2, 100%; E1, 100%; E2, 100%; B1, 77.3%; B2, 100%; IM1, 92.0%; IM2, 98.0%; P < 0.05). Extended milk-fed rearing tended to increase B1 losses (84.8 vs 69.7%; P = 0.148), which should be confirmed with a larger kid number. V1 were removed at 1 yr of age. Lost B1 during the experiment were replaced with B2 boluses (n = 21). Finally, at 18 mo of age, average retention rate of devices were: bolus, 62.5% (B1, 68.2%; B2, 78.6%; P = 0.087); injectable, 93.3% (IM1, 91.4%; IM2, 96.0%; P = 0.333); and, electronic ear tag, 100% (E1, 100%; E2, 100%). Mini-bolus showed the lowest retention (P < 0.05) when compared to ear tag and injectable. In conclusion, only electronic ear tags proved to be efficient devices for the identification of goats from suckling to adult, and new bolus designs are required for the electronic identification of goat in practice.

Key Words: Ear tag, Electronic Identification, Goat

M285 Performance of milk recording procedures based on visual or electronic identification in dairy goats. A. Ait-Saidi, G. Caja*, S. Carné, and A. A. K. Salama, *Universitat Autònoma de Barcelona*, *Bellaterra, Spain*.

A group of 24 Murciano-Granadina dairy goats at early-mid lactation (60 to 120 DIM; 1.44 to 2.41 L/d) was used to compare labor time and data collection efficiency of using manual or semi-automated systems for milk recording on-field conditions. Goats were milked in a 2 × 12 parallel platform with 6 milking units by side (3 units/operator), automatic head lockers and manual concentrate feeding and goat releasing. Manual (M) system used visual identification (48 × 38 mm plastic ear tags recorded with 3 digits), on paper data recording (ear tag number, milk yield and observations) and typing for uploading data to a computer. Semi-automated (SA) system used electronic identification (75 g boluses, 21 × 68 mm; containing HDX transponders, 32 × 3.8 mm, Rumitag, Barcelona, Spain) and reading (hand-held reader with stick antenna; Smart-reader, Rumitag), data recording by typing on reader keyboard (milk yield and observations) and automatic data uploading to computer by blue-tooth connection. Data were collected by groups of 12 goats in 10 milk recordings of each system done during an interval of 55 d. Although there was no difference between M and SA in milk recording time corrected by milk yield (0.72 ± 0.04 min/L/goat, on average), a marked difference was observed for time needed for transferring data of series of 24 goats to the computer (M, 0.22 ± 0.02 min/goat; SA, 0.05 ± 0.01 min/goat; P < 0.001). Total milk recording time corrected by yield and per goat was lower (P < 0.01) in SA than in M (0.77 vs 0.93 min/L/goat). Time necessary for transfering milk recording data of groups 24 goats was 5.24 and 1.25 min for M and SA, respectively. Data transfer time increased by 0.2 min for each additional 24 goats in the SA system. Consequently,

differences in estimated labor time for downloading data between both systems increased with number of goats recorded in the same test day, being: 4.0, 14.2, 29.4, 44.7, 59.9, and 75.2 min; for: 24, 72, 144, 216, 288, and 360 goats, respectively. Differences in labor time cost ($15/h) ranged from $1.0 to $18.8 per milk recording, in favour of using electronic identification.

Key Words: Electronic Identification, Milk Recording, Dairy Goats

M286 Is ethanol production sustainable? An animal science approach. H. Koknaroglu[1], T. Purevjav*[1], T. Akunal[2], and M. P. Hoffman[1], [1]*Suleyman Demirel University*, *Isparta, Turkey*, [2]*Iowa State University*, *Ames*.

A three-year grazing and feedlot finishing trial was conducted to examine the inclusion of condensed corn distillers solubles (CCDS) on sustainability of cattle feeding program. Cultural energy (CE) is the energy other than solar energy needed to produce food and fiber and energy output/input ratios is one of the most useful methods to examine the potential long-term sustainability of various agricultural practices and this analysis is performed to quantify the energy return from products produced relative to the CE invested to produce the product. CCDS is a by-product of ethanol production and is a valuable feed resource that can be used with corn stalks to feed cattle. In our research, we assumed that CCDS and corn stalks have no CE embedded. Each year, calves (n=112) were assigned to four treatment groups by weight and color pattern. Treatments 1 and 2 were pasture (P) rotational grazing (May-September) followed by feedlot finishing (FL) on chopped alfalfa hay and corn (P/FL) or corn, corn stalks and CCDS (P+CCDS/FL), respectively. Cattle in treatments 3 (FL) and 4 (FL+CCDS) were fed in the feedlot from May until harvested. The FL included chopped alfalfa hay and corn, and FL+CCDS included corn, corn stalks, and CCDS. Cattle were weighed every 28 days, and about 586 kg live weight, they were harvested. CE used for pasture establishment, feed consumption, and maintenance were calculated using the actual inputs and corresponding energy values from the literature. FL had higher total CE expenditures and pasturing decreased total CE expenditures ($P<0.01$). Feed energy comprised more than half of the total CE and was highest for FL and was lowest for P+CCDS/FL ($P<0.01$). Kilocalories of CE required to produce kilocalories of protein energy was lower for cattle receiving CCDS ($P<0.05$). Results showed that including CCDS and corn stalks into cattle feeding programs saved 480.5 Mcal CE expended per head corresponding to more than 10% of total CE expended. Thus this shows that CCDS and corn stalks are an effective way to reduce CE expenditure of cattle feeding and this amount will help to increase sustainability of ethanol production.

Key Words: Condensed Corn Distiller Soluble, Feedlot Cattle, Ethanol

M287 Impact of producing low DCAD forage on chloride farm-gate balance. O. Soucy*, D. Pellerin, E. Charbonneau, and G. Allard, *Universite Laval*, *Quebec, Canada*.

The addition of chloride (Cl) to prepartum dairy cow diets can reduce incidence of milk fever by reducing their dietary cation-anion difference (DCAD). Chloride can be added in the ration as anionic salts or be included through forage produced on the farm and fertilized with $CaCl_2$. Both practices have an impact on the Cl farm balance. The objective of this study was to model the Cl cycle on dairy farms and to compute their farm-gate Cl balances according to two scenarios: 1- actual farm data; 2- actual farm data with production of low DCAD forage. The N-CyCLE model has been modified to describe the Cl cycling and to compute the farm-gate balance for Cl. The model was run with data from 18 farms from two different areas of the Quebec province. In scenario 2, a 160 kg / ha application of $CaCl_2$ was added on each 3.7 ha necessary to feed 50 lactating cows. Average Cl farm-gate balance is 2559 kg. It varies from -705 kg to 5441 kg. The high variability can be linked to the Cl in purchased feed, which varies from 1187 to 6260 kg Cl, and the Cl in crops sold, which varies from 1153 to 3380 kg Cl. On a milk production basis, Cl input by feed purchased is quite stable with an average of 5.7 kg Cl /hL. A larger variability is observed with Cl sold as crops, it accounts for 4.4 kg Cl /hL, varying from 2.9 to 12.2 kg Cl /ha. The environmental impact, predicted using the Cl balance expressed on a land basis, is, on average, 17.1 kg Cl / ha but varies from 5.3 to 29.9 kg Cl /ha. The production of low DCAD forage leads to an average farm-gate balance of 2969 kg Cl, varying from -457 to 6092 kg Cl, this represents a mean increase of 16 %. As expected, such an increase depends on the existent Cl global farm balance: for the farm with the minimum global balance, -705 kg Cl, the increase is 35% but it is only a 12% increase for the farm with the maximum balance of 5441 kg Cl. In order to predict the environmental impact of a management practice such as Cl fertilization, our data suggest that the Cl balance should be computed for every farm since a high variability exists between farms.

Key Words: Chloride, Balance, Model

M288 The effect of dehorning at twenty-eight days of age on calf growth and health. B. L. Miller*, T. J. Earleywine, and T. E. Johnson, *Land O'Lakes, Inc.*, *Webster City, IA*.

Three hundred seventy two (372) 3 to 5 day old Holstein bull calves (mean BW=45.3 kg) were employed in two 42 day trials. These animals were employed to understand the impact of de-horning on performance and health. Not dehorned (NDH) or dehorned (DH) were stratified across different dietary treatments by initial weight and blood IgG status. No interactions were noted thus only main effects for dehorning treatments are presented. Calves were fed an average 359 g of a milk replacer twice daily. The milk replacer contained 20% fat and either 22% or 25% protein. Milk replacer was not medicated. Calf starter (18% CP) was fed throughout these trials. Calves assigned to the DH treatment were dehorned at 28 days of age via hot-iron method. Total gain, intake, respiratory and treatments costs were not impacted by dehorning ($P>.05$). Dehorning of calves at twenty eight days of age does not appear to influence calf growth or health.

Table 1.

Item	NDH	DH
No. calves	188	184
D 28-42 gain, kg	9.34	9.26
D 28-42 milk replacer intake, kg	7.51	7.49
D 28-42 starter intake, kg	8.90	9.31
D 28-42 respiratory days	.27	.33
D 28-42 treatment cost, $	.84	.91

all means NS ($P>.05$)

Key Words: Calf, Dehorning, Milk Replacer

M289 Temperament and chute exit velocity scores of Senepol calves after weaning. R. W. Godfrey and R. C. Ketring*, *University of the Virgin Islands, Agricultural Experiment Station*, *St. Croix, US Virgin Islands*.

The objective of this study was to evaluate the temperament and chute exit velocities (EV) of weaned Senepol calves. Bull (n =14) and heifer (n= 30) calves were evaluated at an age of 8.7 ± 0.4 mo (d 0) using chute score (CS) and EV as indicators of temperament. All calves were fire branded with the herd identification on d 0, after the initial CS and EV were measured, and a second EV was recorded at this time (BRND). On d 49 CS and EV were measured again for all calves. The CS was determined on a 1 to 5 scale with 1 being calm and 5 being extremely agitated. Chute exit velocity, reported in m/sec, was measured as the animals exited the chute using an electric timing system. There was no difference ($P > 0.10$) in any trait measured between bulls and heifers so data were pooled across sex. There was no difference ($P > 0.10$) in CS of calves measured at d 0 or d 49 (2.1 ± 0.1 vs. 2.2 ± 0.2, respectively). Only 6.8 % of the calves had a CS greater than 3 ($P < 0.006$). Calves had a greater EV at BRND ($P < 0.0009$) than at either d 0 or d 49 (3.1 ± 0.1 vs. 2.4 ± 0.1 vs. 2.4 ± .01 m/sec, respectively). At d 0 calves with a CS of 1 had a lower ($P < 0.03$) EV compared to calves with a CS of 2, 3 or 4 (1.7 ± 0.3 vs. 2.3 ± 0.2 vs. 2.6 ± 0.2 vs. 3.0 ± 0.5 m/sec, respectively). At d 49 EV of calves with a CS of 1 was lower ($P < 0.01$) than that of calves with a CS of 2, but not different ($P > 0.10$) from calves with a CS of 3 or 4 (1.9 ± 0.2 vs. 2.7 ± 0.2 vs. 2.3 ± 0.2 vs. 2.9 ± 0.6 m/sec., respectively). There was no difference ($P > 0.10$) in weaning weight among calves that received CS of 1, 2, 3 or 4 at day 0 or d 49. Overall CS and EV had a moderate correlation ($P < 0.002$, $r = 0.359$). At d 0 CS and EV had a moderate correlation ($P < .004$, $r = 0.446$) but not at d 49 ($P > 0.10$, $r = 0.209$). There was no correlation ($P > 0.10$) between weaning weight and EV at d 0 or d 49. At BRND EV tended to have a negative correlation with weaning weight ($P < 0.07$, $r = -0.298$). These results show that the temperament of Senepol calves does not change significantly over time after weaning.

Key Words: Temperament, Cattle, Behavior

M290 The effect of calf ear infection (otitis media) on calf growth and health. B. L. Miller*, T. J. Earleywine, and T. E. Johnson, *Land O'Lakes, Inc.*, *Webster City, IA*.

The Land O'Lakes Research facility in Webster City, IA conducts trials with over 1500 three-to-five day old Holstein bull calves annually. These calves are co-mingled sale barn calves purchased from Wisconsin. Upon the completion of research trials, these calves have been sold to local producers. However, during the last six years *Micoplasma bovis* infection has reduced the value and number of saleable calves. To better understand the full impact of ear infection (otitis media), calf performance, health and total treatment costs were examined. One hundred thirty-one (131) Holstein bull calves (mean BW=45.2 kg) were employed in this 42 day trial. All calves were fed 340 g of a 20% all-milk protein, 20% fat milk replacer (MR) twice daily. Milk replacer was not medicated. Calf groups were formed by treatment for ear infection (1. no clinical signs, no antibiotic treatment; 2. clinical signs with antibiotic treatment for 1 - 6 days; or 3. clinical signs with antibiotic treatment for over 6 days). Daily antibiotic (AB) treatment was approved extra-label use of Lincomycin (.45 g/d) and Spectomycin (.33 g/d) intramuscular injection. Antibiotic treatment was not related to initial weight or blood gamma globulin status. Calf starter (18% CP) was fed throughout this trial. Total gain, MR intake and starter intake were reduced ($P<.05$) for calves having clinical signs of ear infection and treated for more than six days compared with non-clinical, non-treated calves. Total calf treatment cost increased with number of treatment days.

Table 1.

Item	No clinical/ No AB	Clinical/ 1-6 d AB	Clinical/ 6+d AB
No. calves	77	33	21
Total gain, kg	14.0[a]	12.7[a,b]	11.0[b]
Total milk replacer intake, kg	26.4[a]	26.1[a,b]	25.5[b]
Total starter intake, kg	7.9[a]	6.6[a,b]	4.9[b]
Total respiratory days	2.2[b]	4.0[a]	3.4[a,b]
Total calf otitis media cost, $	0.00[c]	8.84[b]	19.82[a]
Total calf treatment cost, $	10.56[c]	22.15[b]	36.97[a]

[a,b,c] $P<.05$

Key Words: Calf, Ear Infection, Milk Replacer

M291 Feeding behavior and weight gain of calves fed low or high quantities of milk using an automated feeding system. T. F. Borderas*[1,2], A. M. dePassillé[1], and J. Rushen[1], [1]*Agriculture and Agri-Food Canada*, *Agassiz, B.C., Canada*, [2]*University of British Columbia*, *Vancouver, B.C., Canada*.

There is interest in feeding unweaned calves more milk but little is known about feeding behavior in group-housed calves fed with an automated feeder. In two experiments, we examined the effect of low and high milk allowances on behavior and weight gain of Holstein calves fed on an automated feeder. In Exp. 1, we fed calves either 4L/d milk replacer (N=25) or to ad libitum intake (N=25) to 42d of age. In Exp. 2, calves were fed 4L/d (N=14) or 12L/d (N=14) of whole milk to 32d. Calves were housed in dynamic groups of 3 to 15. Results were analysed using a mixed model with calf, treatment and age as factors. Differences were significant at P=0.05. Calves with a high milk allowance consumed more milk (Mean±SD Exp 1: 13.4 ± 1.9 L /d, Exp 2: 8.9 ± 0.7) than calves fed 4L/d. Low milk fed calves made more visits to the milk feeder than high milk fed calves (Exp 1: 22.9 ± 5.1 vs. 11.4 ± 3.5; Exp 2: 22.3 ± 5.8 vs. 11.7 ± 2.4). To d14, calves ate less than 200 g/d of concentrate and there were no differences between treatments (P>0.10) After d14, high fed calves ate less grain (Exp 1 : 17.3 ± 4.7 g/d; Exp2: 110.1 ± 33.4 g/d) than low fed calves (Exp 1: 793.8 ± 87.9 g/d ; Exp2: 581.5 ± 149.1). At 2 wk of age, there were no differences in time spent resting between treatments, but in wk 4 and 5, high milk-fed calves rested for 21.6 ± 10.7 min/d longer than low milk-fed calves. In Exp. 1, weight gains of ad lib fed calves from d0 to d21 were higher (21.96 ± 1.3 kg) than for low milk-fed calves (10.1 ± 0.9 kg). From d21 to weaning, low milk-fed calves gained more than high milk-fed calves (24.8 ± 1.9 vs. 18.1 ± 0.55 kg) but at 42d weaning, body weights of high milk-fed calves were higher (86.9 ± 2.6 vs. 77.6 ± 2.3 kg). Feeding calves more milk improved weight gain until d21 and improved the efficiency of use of the automated feeder. However, feeding more milk reduces concentrate consumption after 14 d and growth advantages after 21 d of age.

Key Words: Dairy, Calf, Feeding

M292 Effect of palm kernel meal plus urea on finishing of Brown Swiss young bulls. J. H. Avellaneda-Cevallos*[1], T. A. Cedeño-Cedeño[1], A. Suárez-Chiquito[1], O. Montañez-Valdez[2], C. D. Cepeda-Cantos[1], R. Luna-Murillo[1], I. Espinoza-Guerra[1], J. Quintana-Zamora[1], and L. Casanova-Ferrín[1], [1]*Facultad de Ciencias Pecuarias, Unidad de Investigación Científica y Tecnológica, Universidad Técnica Estatal de Quevedo*, *Quevedo, Los Rios, Ecuador*, [2]*División de Bienetar y Desarrollo Regional, Departamento de Desarrollo Regional, Universidad de Guadalajara*, *Ciudad Guzmán, Jalisco, México*.

The supplementation of the palm kernel meal (PKM) was evaluated plus urea (U) in 16 castrated cross breed Brown Swiss young bulls with initial average weight 283.75 kg, fed with grass Saboya (Panicum maximum Jacq). The research lasted 90 days. The daily gain of weight (DGW) and total gain (TGW) was evaluated, as was consumption of grass (CG), palm kernel meal (CPKM), total dry matter (TDMC: PKM+CG+U), and the nutritious conversion (NC). A completely random design was used with four treatments and four replications. The treatments were: T0 (control): shepherding; T1: T0+ 1.5 kg DM PKM + 50 g urea/animal; T2: T0 + 2.5 kg DM PKM + 50 g urea/animal; T3: T0 + 3.5 kg DM PKM + 50 g urea/animal. The DGW and TGW, didn't show differences ($p>0.05$) between the animals supplemented, but there were differences between these and T0 ($p<0.05$). The DGW improved when adding PKM+U to the diet, obtaining the best value with T3. The CG didn't present differences ($p>0.05$) between the treatments. The TDMC presented differences ($p<0.05$), the T3 had the most consumption. The NC between the supplemented treatments (T1, T2, and T3) didn't present differences ($p>0.05$), but it was differences were observed ($p<0.05$) when comparing them with the T0.

Table 1.

	T0	T1	T2	T3	SEM	p<
Initial weight, kg	284.25[a]	279.75[a]	290.50[a]	280.75[a]	3.08	0.68
Final weight, kg	316.75[b]	341.50[ab]	348.50[a]	351.75[a]	0.02	0.01
DGW, kg	0.36[b]	0.70[a]	0.65[a]	0.79[a]	0.02	<0.01
TGW, kg	32.50[b]	63.25[a]	58.25[a]	71.00[a]	1.99	<0.01
CPKM, kg/d	-	1.39[c]	2.10[b]	3.11[a]	0.02	<0.01
CG, kg/d	6.41[a]	6.63[a]	6.80[a]	6.76[a]	0.06	0.19
TDMC, kg/d	6.41[d]	8.03[c]	8.90[b]	9.86[a]	0.07	<0.01
NC,d	17.68[a]	11.45[b]	13.67[b]	12.80[b]	0.38	<0.01

Value within each row with common superscripts no differ (Tukey: $P<0.05$)

Key Words: Palm Kernel Meal, Supplementation, Gain of Weight

M293 Effect of heat processing on ruminal and post-ruminal disappearance of individual amino acids of Iranian whole soybeans. M. H. Fathi Nasri*[1] and M. Danesh Mesgaran[2], [1]*University of Birjand*, *Birjand, Iran*, [2]*University of Mashad*, *Mashad, Iran*.

The effect of heat processing (roasting and steep-roasting) on ruminal degradability and intestinal digestibility of individual amino acids (AA) in two Iranian whole soybean cultivars (Sahar and Williams) was determined using the mobile nylon bag technique. The seeds were roasted at 140 to 145ºC using a drum roaster (for 1.5-2 min). A fraction of the seeds were cooled immediately and the rest were held in isolated barrels for 45 minutes (steeping). The ruminal degradability of all AA of heat processed soybeans was reduced significantly ($P<0.001$) compared to raw seeds, however, among the individual AA there was variation in ruminal degradation, so that, in both raw and heat processed seeds Arg, Lys, Glu, Asp were degraded to a relatively high degree, whereas Leu, Ile, Met, Phe, Tyr, Thr, and to some extent, Val, Ala were degraded to a relatively low degree. Roasting increased the intestinal digestibility of total and individual AA in residues after rumen incubation, significantly ($P<0.001$), and steeping intensified it, showing beneficial effects of steeping beyond roasting (12.3 % and 18.5 % for total AA, respectively), however, variations in digestibility of the individual AA were found. Total tract disappearance of total AA was higher for raw than roasted seeds, due to higher AA degradability of raw seeds. Among individual AA, some had the higher total tract disappearance in raw seeds and some in heated seeds. There was no significant difference between the two soybean cultivars in respect to AA ruminal degradability, intestinal digestibility and total tract disappearance. The interaction between cultivar and heat processing was not significantly different either. Roasting and steep-roasting were effective methods of changing the site of digestion from rumen to small intestine and therefore the amount of digestible undegraded AA in small intestine was increased.

Key Words: Whole Soybean, Amino Acid, Mobile Nylon Bag

M294 *In situ* ruminal degradability of dry matter and crude protein of cottonseed meal containing different fat concentrations. M. Danesh Mesgaran*, A. Heravi Moussavi, and S. Danesh Mesgaran, *Department of Animal Science (Excellence Center for Animal Science), Ferdowsi University of Mashhad*, *Mashhad, Iran*.

The objective of this study was to determine *in situ* ruminal degradability of DM and CP of 3 cottonseed meals containing different fat concentrations [low (CSl), medium (CSm) and high (CSh); 5, 30 and 60 g/kg, respectively) produced in various Iranian oil industries. Cottonseed CP levels ranged from 288 (CSh) to 395 (CSl) g/kg DM. Four ruminally fistulated steers (400±20 kg, body weight) were used. Bags (12×19 cm, pore size of 48 tμm) containing 5 g DM of each sample was incubated in the rumen (4 replicates per each animal) for 0.0, 2, 4, 8, 16, 24, 48 and 72 h. Ruminal DM and CP disappearance rates was analyzed using a negative exponential model. Relative to the other cottonseed meals, CSl had the highest *in situ* quickly degradable (a) DM fraction (0.39). No difference in (a) fraction of DM was observed between CSm (0.33) and CSh (0.30). In situ (a) fraction of CP ranged from 0.33 for CSh to 0.41 for CSl. Slowly degradable (b) fraction of DM and CP was not similar among the cottonseed meals (CSl= 0.39 and 0.42, CSm= 0.34 and 0.31, CSh= 0.31 and 0.34, respectively). CSh had a lower rate of degradation (c) of DM and CP (0.04 and 0.05, respectively) compared with CSl (0.06 and 0.08, respectively). It was concluded that differences in ruminal degradable parameters exist between cottonseed meals with different fat levels, with more variations observed for ruminal CP than for DM degradability.

Key Words: Cottonseed Meal, Degradability, Crude Protein

M295 The effect of fat content on ruminal and post-ruminal protein disappearance of cottonseed meal using *in situ* mobile bag and alternative enzymatic procedures. M. Danesh Mesgaran*, M. Vatandoost, H. Jahani Azizabadi, and A. Heravi Moussavi, *Department of Animal Science (Excellence Center for Animal Science), Ferdowsi University of Mashhad*, *Mashhad, Iran*.

Ruminal, post-ruminal and total tract crude protein (CP) disappearance from various cottonseed meals [low (CSl), medium (CSm) and high (CSh) fat; 5, 30 and 60 g/kg, respectively) were evaluated using the in situ mobile nylon bag technique, an *in vitro* enzyme procedure and a three-step *in situ/in vitro* enzyme procedure. Results from the current study using different procedures showed relatively lower ruminal and post-ruminal digestibility values for CSh and CSm compared with CSl. Mean ruminal CP disappearance of CSl (0.68) was higher (P < 0.05) than CSm and CSh (0.59 and 0.57, SEM=0.03, respectively). There was a significant effect (P < 0.05) of fat content of cottonseed meal on post-ruminal CP disappearance (CSl= 0.94, CSm= 0.88, CSh= 0.76, SEM= 0.03). Total tract CP disappearance of CSl (0.96) was also significantly higher (P < 0.05) than CSm and CSh (0.88 and 0.79, SEM= 0.04, respectively). Ruminal, post-ruminal and total tract protein disappearance of various cottonseed meals followed non significant patterns with the different procedures used in this study. The coefficient of determination (r2) for the relationship of total tract CP disappearance between the mobile nylon bag technique and *in vitro* and three-step procedures was 0.67 and 0.69, respectively. It may be concluded that the different ruminal and post-ruminal diappearance of CP of cottonseed meal, using different procedures, might be due to the fat content of the samples evaluated in the present study.

Key Words: Protein Disappearance, Three-Step Procedure, In Vitro

M296 A comparison of synchrotron and globar Fourier transform infra-red microspectroscopy (FTIRM) use in predicting cereal grain rumen degradation characteristics. A. M. Walker*, C. R. Christensen, D. A. Christensen, P. Yu, H. C. Block, and J. J. McKinnon, *University of Saskatchewan*, *Saskatoon, SK, Canada*.

The DM, CP, and starch degradation characteristics of one corn and four barley grain varieties were evaluated in two *in situ* nylon bag trials. Trial 1 was a 2 × 2 factorial comparing ground or rolled Harrington barley and Pioneer 39P78 corn. Trial 2 was a 2 × 4 factorial comparing ground or rolled CDC Bold, CDC Dolly, Harrington, and Valier barley. Spectra from reflectance mode globar-based FTIRM were collected on five seeds from each grain using the mid-IR end station at CLS (Saskatoon, SK). Spectra from transmission mode synchrotron-based FTIRM were collected on five seeds from Harrington and Valier barley and Pioneer 39P78 corn grain using the U2B beam line at NSLS-BNL (Upton, NY). Carbohydrate (CHO):amide I spectra peak area ratios were compared to in situ results to determine if FTIRM spectra related to degradation rate differences, and if globar and synchrotron based FTIRM differed. Trial 1 had grain x processing interactions (P<0.01) with Harrington barley degradation rates increasing more (P<0.05) with grinding. Trial 2 had barley variety x processing interactions (P<0.05) with the greatest (P<0.05) degradation rate differences occurring with ground CDC Bold and CDC Dolly vs. Harrington and Valier barley. Both globar- and synchrotron-based FTIRM found CHO:Amide I peak area ratios were greater (P<0.05) for corn than Harrington barley. This suggests high CHO:Amide I peak area ratios indicate reduced degradation rates. However, this relationship reversed when comparing barley varieties with globar FTIRM where varieties with higher (P<0.05) CHO:Amide I peak area ratios generally had higher (P<0.05) degradation rates. Synchrotron FTIRM comparison of Harrington and Valier barley failed (P=0.41) to identify differences in CHO:Amide I peak areas. These results suggest FTIRM spectral features may relate to cereal grain degradation characteristics, but additional research is required to characterize these relationships and compare spectra collection methods.

Key Words: Synchrotron, Infra-Red Spectra, Rumen Degradation

M297 *In situ* ruminal disappearance of acid detergent insoluble nitrogen (ADIN) of various feeds. H. Jahani-Azizabadi, M. Danesh Mesgaran*, R. Valizadeh, and H. Nasirimoghadam, *Ferdowsi University of Mashhad*, *Mashhad, Iran*.

In situ ruminal disappearance of acid detergent insoluble nitrogen (ADIN) of alfalfa hay, alfalfa silage, corn silage, corn grain, barley grain, cottonseed meal and canola meal was determined. Two rumen fistulated Holstein steers (450±50 kg, body weight) were used. Steers were fed 5.1 kg of alfalfa hay, 1.2 kg of corn silage and 2.7 kg of concentrate (150 g CP/kg of DM). Approximately, 6 g of each sample (DM) was placed in each bag [polyester nylon bag (9×17 cm, pore size of 52 µm) and incubated in the rumen for 0.0, 12, 24, 48 and 96 h. After removal of the bags from the rumen, they were washed using cold water and dried in a forced air oven (60 0C, 48 h), weighed to determination DM disappearance, and ADIN of the samples determined. Data in each time were statistically analyzed using a completely randomized design. ADIN value for alfalfa hay, alfalfa silage, corn silage, corn grain, barley grain, cottonseed meal and canola meal was 1.6, 3.4, 1.03, 2.25, 0.8, 2.8 and 4.5 g per kg of DM, respectively. Ruminal ADIN disappearance of alfalfa hay, alfalfa silage, corn silage, corn grain, barley grain, cottonseed meal and canola meal after 24 and 96 hours incubation was 0.3 & 0.4, 0.4 & 0.5, 0.3 & 0.5, 0.6 & 0.9, 0.6 & 0.7, 0.3 & 0.5, 0.2 & 0.3 (SEM= 0.02 & 0.02), respectively. The ruminal ADIN disappearance of the corn and barley grains was significantly higher compared with the other feed samples (P <0.05). Results of the present experiment indicated that a part of the ADIN of the feed samples analyzed in the present experiment disappeared in the rumen and the relative disappearance increased when incubation time was increased.

Key Words: ADIN, Disappearance, Rumen

M298 Feed intake and digestibility response of ram lambs fed olive cake ensiled with different feed supplements. F. T. Sleiman*[1], R. E. Issa[1], S. H. Ibrahim[2], M. G. Uwayjan[1], S. K. Hamadeh[1], I. Toufeili[1], and M. T. Farran[1], [1]*American University of Beirut*, *Beirut, Lebanon*, [2]*University of Dohuk*, *Dohuk, Kurdistan, Iraq*.

Previous research (J. Dairy Sci. 89. Suppl.1,P-371) has shown that ensiling high levels (≥ 72%) of olive cake (OC) with different levels of ground yellow corn (GYC), wheat bran (WB), molasses (M) and urea (U) improved apparent digestibility of fiber fractions and silage (S) DMI when fed to goat kids. In this study lower levels of OC were ensiled with the above feed ingredients in order to evaluate feed DMI, apparent digestibility and performance of ram lambs. The experiment utilized 12 lambs in a completely randomized design and consisted of a 4-wk trial including a 1-wk collection period using the following silage treatments: I) 58.55% OC + 21.3% GYC + 10.0% M + 10.0%

water + 0.15% U; II) 65.3% OC + 10.6% GYC + 6.0% WB+ 10.0% M + 8.0% water + 0.1 U; and III) 46.3% OC + 10.6%GYC + 6.0% WB +20% M+ 17.0% water +0.1% U. Each lamb received 0.5 kg/d concentrate (14% CP on DM basis) in addition to ad libitum feeding of the experimental silages. Means were separated using Duncan Multiple Range test. S DMI was not significantly different (P>0.05) among treatments and averaged 261, 220 and 308g/h/d for treatments I, II, and III, respectively. Change in BW was not significantly different (P>0.05) and averaged 112, 105 and 137 g/h/d for the respective treatments. Apparent digestibility of DM, NFE and NDF of treatment I was significantly higher (P<0.05) than that of treatment III (74.0 Vs 58.7%; 88.4 Vs 77.3%; 50.1 Vs 12.9%, respectively). CP, EE, CF and ADF digestibility was not significantly different (P>0.05) among the silage treatments, with treatment I having the highest digestibility coefficients of these fractions (72.0, 59.5, 36.5 and 40.5%, respectively). Results of this study indicated that ensiling OC with the used levels of feed supplements resulted in acceptable DMI, digestibility and animal performance.

Key Words: Ram Lambs, Olive Cake, Apparent Digestibility

M299 Effects of microwave irradiation on protein degradation of safflower meal in the rumen. P. Shawrang*[1] and A. A. Sadeghi[2], [1]*Animal Science Research Section, Research Center for Agriculture and Medicine, Atomic Energy Organization of Iran*, *Karaj, Iran*, [2]*Department of Animal Science, Faculty of Agriculture, Science and Research Branch, Islamic Azad University*, *Tehran, Iran*.

This study was completed to evaluate effects of 1000 W microwave irradiation for 1, 2 and 3 min on protein degradability and intestinal digestibility of safflower meal (SM) by using nylon bags and SDS-PAGE techniques. Duplicate nylon bags of untreated and microwave irradiated SM were suspended into the rumen of four non-lactating Holstein cows from 0, 2, 4, 6, 8, 12, 16, 24 and 48 h, and data was fitted to exponential model to calculate degradation parameters of CP. Increasing irradiation time decreased (P<0.05) the water soluble fraction and increased (P<0.05) the potentially degradable fraction of CP. The degradation rate of the b fraction decreased (P<0.05) with increases in irradiation time. The effective CP degradability of 1, 2 and 3 min microwave irradiated SM at a rumen outflow rate of 0.05/h decreased (P<0.05) by 10, 17 and 20 %, respectively, compared to untreated SM. SDS-PAGE analysis revealed that SM proteins were composed of two major components A and B, accounting for approximately 34 and 51 percent of the total meal protein, respectively. Both proteins were multi-subunits. The molecular weights of 31.9, 26.0, 21.4, 19.5 kDa for A subunits and 8.0, 9.6 kDa for B subunits were observed in this study. Electrophoretic and densitometric analysis of untreated SM protein residues revealed that B subunits were degraded completely within 4-h, whereas the four subunits of A were not degraded after 12-h of incubation. In microwave irradiated SM, B subunits were resistant until 12-h incubation and four subunits of A were not degraded until 24-h of incubation. Mobile bag CP digestibility linearly (P<0.001) increased as irradiation time increased. Intestinal CP digestibility of untreated, 1, 2 and 3 min microwave irradiated SM at 16-h of ruminal incubation period were 807, 838, 855 and 876 g/kg, respectively. Irradiation at this dose for 4 min induced burning of SM. In conclusion, microwave irradiation of SM at power of 1000 W for 3 min appeared to be an effective means of increasing digestible rumen undegradable protein content.

Key Words: Safflower Meal, Microwave Irradiation, SDS-PAGE

M300 Optigen® is a sustained release source of non-protein nitrogen in the rumen. R. Garcia-Gonzalez*[1], J. M. Tricarico[1], G. A. Harrison[1], M. D. Meyer[1], K. R. McLeod[2], D. L. Harmon[2], and K. A. Dawson[1], [1]*Alltech Inc.*, *Nicholasville, KY*, [2]*University of Kentucky*, *Lexington*.

A trial was conducted to study the N release characteristics of Optigen® (Alltech Inc.) in the rumen. Four ruminally-cannulated steers (277 kg average BW) were fed a 60% corn silage, 30% high moisture corn, and 10% supplement diet at 2% of BW in two daily meals. Steers were assigned to urea (0.11 g/kg BW) or Optigen® (0.12 g/kg BW) in cross-over design. Supplements were top-dressed at feeding. Each period consisted of a 21-d adaptation period and a 3-d sample collection period. On day 22, jugular blood and ruminal samples were collected for up to 8 h post-feeding. Ruminal fluid was analyzed for ammonia, pH and VFA content and blood plasma for ammonia, urea and glucose content. On day 23, disappearance of Optigen® NPN in the rumen was studied *in situ*. Bags with residue were not washed after *in situ* incubation but were placed in acidified water, sonicated, and analyzed for residual urea. On day 24, ruminal and blood samples were collected after intra-ruminal administration of Optigen® or urea prior to the morning feeding. Non-linear modeling of *in situ* NPN disappearance resulted in 7% NPN available at time 0h and a disappearance rate of 0.237 h^{-1} for the NPN fraction released over time. No differences in ruminal pH, VFA, or blood glucose concentrations were observed after urea or Optigen® administration. Ruminal ammonia concentrations were lower in steers fed Optigen® vs. urea (5.3 vs. 6.6 mg/dL, $P<0.05$) on day 22. Differences were greater when Optigen® or urea were administered intra-ruminally on day 24, possibly due to differential eating behavior between steers on day 22. Ruminal ammonia concentrations (mg/dL) were lower ($P<0.05$) in steers receiving Optigen® vs. urea at 2 (16.3 vs. 28.4) and 4 h (1.9 vs. 9.3). Jugular plasma ammonia concentrations peaked at 2 h post-administration of urea (0.216 mM) while they remained constant (0.069 mM average) throughout the same 8-h period in steers receiving Optigen®. Jugular blood plasma urea concentrations were lower ($P<0.05$) in steers receiving Optigen® vs. urea at 4 (4.00 vs. 4.82 mM) and 6 h (3.24 vs. 4.26 mM). This study suggests that Optigen® is a protected source of NPN with sustained release characteristics in the rumen.

Key Words: NPN, Urea, Ammonia

M301 Effects of Optigen® on fermentation, digestion, and N partitioning in rumen-simulating fermenters. G. A. Harrison*, J. M. Tricarico, M. D. Meyer, and K. A. Dawson, *Alltech Biotechnology*, *Nicholasville, KY*.

The effects Optigen® (blended, controlled-release urea) on ruminal fermentation, digestion, and N flow were investigated in single-flow rumen-simulating fermenter cultures. Data from 10 experiments were included in this meta-analysis (all-natural protein: 52 cultures; Optigen: 52 cultures). Cultures were fed diets with a forage base of corn silage and alfalfa hay, 45 to 50% forage (DM basis) and NPN from Optigen at 0.44 to 0.66% dietary DM. NPN from Optigen replaced 6.0 to 9.8% of dietary N. Cultures were fed 12.5 g as fed of experimental diets twice daily for six days. Target dilution rate with McDougall's artificial saliva solution diluted 70:30 with tap water was 0.045 h^{-1}. Samples were collected from all cultures immediately prior to morning feeding during the last 3 days of experiments for fermentation analysis. Effluent weights were recorded each day and a composite sample

for each fermenter was used for DM, OM, and NDF disappearance determination. Nitrogen flow measures were estimated by using purine to N ratios for effluent DM and bacteria. Data were analyzed using the PROC MIXED Model of SAS. Culture fluid pH was not affected by diet (6.42 vs. 6.45; $P>0.10$). Cultures fed all-natural protein diets had higher total VFA concentrations (75.5 vs. 69.1 mM, $P<0.05$) than Optigen-fed cultures. Ammonia (prior to morning feeding) was similar between culture diets (4.24 vs. 4.43 mg/dl, $P>0.10$). Apparent and true DM digestion were not affected by culture diet ($P>0.10$). Cultures receiving Optigen had higher protein degradability (63.5 vs. 65.3% of CP, $P<0.05$) and less undegraded feed N (0.239 vs. 0.228 g/d, $P<0.05$) than all-natural protein cultures. Bacterial N yields (0.323 vs. 0.324 g, $P>0.10$) and efficiency (23.3 vs. 23.3 g bacterial N/kg DM truly digested, $P>0.10$) were not altered by culture diet. We conclude that Optigen can replace up to 9.8% of dietary N in rumen-simulating fermenter cultures without negative effects on fermentation, digestion, or N partitioning.

Key Words: Non-Protein Nitrogen, Optigen, Ruminal Metabolism

M302 The effect of fat content of sodium hydroxide treated sunflower meal on *in situ* dry matter and crude protein degradation parameters. T. Mohammadabadi, M. Danesh Mesgaran*, A. R. Heravi Moussavi, H. Nasiri Moghadam, and M. Chaji, *Ferdowsi University*, *Mashhad, Iran*.

This study was conducted to evaluate *in situ* dry matter (DM) and crude protein (CP) degradation parameters of sunflower meals (containing 25 (SFM25) or 150 (SFM150) g fat/kg DM). Samples were untreated (SFM25U or SFM150U) or sodium hydroxide (40g/kg DM) treated (SFM25T or SFM150T, respectively). CP content of sunflower meals ranged from 232 (SFM150T) to 338 (SFM25U) g/kg DM. Four ruminally fistulated Holstein steers (400±12 Kg, body weight) were used. Approximately, 5 g DM of each sample were placed into bags (12x19 cm), made of polyester cloth with 52 µm pore size (4 replicates per each treatment). Bags were incubated in the rumen for 0.0, 2, 4, 6, 8, 16, 24, 48, 72 and 96 h. The degradable parameters of DM and CP were determined using the equation of P=a + b (1 - e^-ct). SFM150T had the highest rapidly degradable fraction (a) of DM (0.43) compared with the other samples. There was no difference in (a) fraction of DM between SFM150U (0.39), SFM25T (0.32) and SFM25U (0.33). In situ (a) fraction of CP of SFM150U was the lowest, but there was no difference in (a) fraction CP between SFM150T (0.39) and SFM25T (0.38). Slowly degradable fraction (b) of DM of SFM25T was the highest (0.42) and SFM150T was the lowest (0.31) compared with the other samples and (b) fraction of CP ranged from 0.32 for SFM25U to 0.63 for SFM150U. No difference in (b) fraction of CP of SFM150T (0.59) and SFM25T (0.57) was observed. SFM150T had the lowest of fractional degradation rate (c) of DM (0.05) and CP (0.04) and SFM25U had the highest of (c) fraction of DM (0.16) and CP (0.11) compared with the others. It was concluded that the potential degradation of SFM might be affected by the fat content and sodium hydroxide treatment.

Key Words: In Situ, Sunflower Meal, Sodium Hydroxide

M303 Pistachio hull tannin affected digestibility of soybean meal and alfalfa during *in vitro* digestion. A. Bohluli and A. A. Naserian*, *Ferdowsi University*, *Mashhad, Iran*.

Due to binding tannin with protein and cellulose, it was hypothesized that pistachio hull tannin can decrease the digestibility of soybean meal (47% CP and 19% NDF) and alfalfa (18% CP and 34% NDF). Pistachio Hull (PH) is the main pistachio by-product produced from the pistachio dehulling process. PH consisted of 12.7, 5.7, 16.6, 25, and 20% ash, EE, CP, NDF, and ADF, respectively; also it contained a 9.6% total phenolic component and 4.5% tannin determined using Folin-Ciocalteu reagent with a calorimetric method. Poly Ethylene Glycol (PEG) was used as a tannin binder for its ability to counteract the action of PHT on digestibility of SBM and alfalfa. The SBM and alfalfa were incubated separately, with PH in 50:50 ratios or by adding PEG into the mixtures. Dry Matter and Organic Matter Digestibility (IVDMD and IVOMD) of the treatments were determined using a in vitro 2-step digestion technique (48h incubation in a rumen microbial culture and 48h digestion after HCl-pepsin solution addition). PEG enhanced dry matter and organic matter digestibility of the PH+SBM and the PH+alfalfa mixture ($P<0.05$) and its effect was higher for the PH+alfalfa ($P<0.01$). These results suggest pistachio hull tannin prevented digestion of high protein and structural carbohydrate feed sources. In this study, PHT inhibited fiber more than protein digestion. It is maybe because of the addition of HCl-pepsin solution in the second step of in vitro digestion, which may have eased the tannin-protein complex and improved protein digestion in the second step of digestion by pepsin; whereas the structural carbohydrate can only be digested in the first step.

Table 1.

Item	SBM	Alfalfa	PH	SEM
IVDMD	89.0	70.1	62.5	
IVOMD	89.7	71.0	67.4	
	SBM+PH	SBM+PH+PEG		
IVDMD	78.8	82.0		0.43
IVOMD	82.4	85.8		0.47
	Alfalfa+PH	Al+PH+PEG		
IVDMD	68.0	70.7		0.26
IVOMD	70.2	74.7		0.27

Key Words: Pistachio Hull, Tannin, Poly Ethylene Glychol

M304 Comparison of ruminal *in situ* crude protein degradability of selected feedstuffs in growing goats. Y. Hu*[1], Z. L. Tan[1], S. X. Tang[1], Z. H. Sun[1], M. Wang[1], and G. O. Tayo[1,2], [1]*Institute of Subtropical Agriculture, The Chinese Academy of Sciences*, *Changsha, P.R. China*, [2]*Babcock University*, *Ikeja Lagos, Nigeria*.

The objective of this study was to update the feed database on ruminal crude protein (CP) degradability in China. Ruminal in situ CP degradability of three classes of feedstuffs, namely cereal grain (barley, buckwheat, rice and millet), legume (horse bean, pea, mung bean and jequirity), and tuber (potato, sweat potato and cassava) were determined using the *in situ* nylon bag technique. All feed samples were collected from the main production regions in China. Three wether goats (20±1 kg) were used and fed a diet consisting of 500 g kg^{-1} concentrate and 500 g kg^{-1} forage containing DE (3.15 Mcal/kg DM)

and CP (140 g/kg DM). Ruminal CP degradability of each feedstuff was measured at 0, 2, 4, 8, 12, 24 and 36h in duplicate for each goat. The in situ CP disappearance data were fitted to the equation p=a+b (1-e^{-ct}). For cereal grain feedstuffs, the rapidly soluble fraction (a), potentially degradable fraction (b), and degradation constant rate (c) of fraction b was highest for barley, rice, and barley or buck wheat, respectively. For legume feedstuffs, Pea had the highest value of 'a', while 'b' and 'c' values were highest for soybean and horse bean. For tuber feedstuffs, potato had the highest values of 'a' and 'c', and the lowest value of 'b'. Results indicated that ruminal in situ CP degradability of these classes of feedstuffs varied widely. These data could be practically applied in formulating total mixed rations for ruminant production in China.

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Table 1.

Feedstuff		a	b	c
Cereal grain	Barley	548^{a}	291^{b}	0.13^{a}
	Rice	309^{cd}	571^{a}	0.02^{c}
	Buckwheat	386^{b}	348^{b}	0.13^{a}
	Millet	68^{f}	373^{b}	0.06^{b}
Legume	Horsebean	555^{bc}	141^{b}	0.07^{a}
	Jequirity	530^{c}	219^{a}	0.04^{bc}
	Mung bean	623^{b}	178^{ab}	0.03^{c}
	Pea	723^{a}	110^{b}	0.05^{b}
Tuber	Sweat potato	593^{b}	121^{b}	0.12^{a}
	Cassava	553^{c}	286^{a}	0.05^{b}
	Potato	842^{a}	61^{c}	0.12^{a}

Key Words: Feedstuffs, Ruminal In Situ Degradability, Crude Protein

M305 Effect of replacing soybean meal with *Mucuna pruriens* on growth performance, carcass characteristics and meat safety. S. K. Chikagwa-Malunga*[1], A. T. Adesogan[1], M. Huisden[1], S. C. Kim[1], S. C. Phatak[2], N. J. Szabo[1], and R. C. Littell[1], [1]*University of Florida*, *Gainesville*, [2]*University of Georgia*, *Tifton*.

The harmful effects of the L-dopa in *Mucuna pruriens* (M, Velvet bean) seeds have limited its use as a protein supplement for monogastrics and humans. This study determined how replacing soybean meal (SB) with M affects the performance of lambs and meat safety. Twenty-seven Rambouillet lambs (RM; initial BW = 33.8 ± 5.4 kg) and twelve Florida Native (FN; initial BW = 24.9 ± 8.6 kg) lambs were assigned to four treatments and fed a basal diet of coastal bermudagrass hay, corn, and molasses for 42 (FN) or 49 d (RM) and then harvested. Dietary supplements were formulated by substituting 0 (SB), 33 (Lo), 67 (Med) or 100 (Hi) % of SB with rolled M seeds. Body weight was measured weekly and carcass characteristics and concentrations of L-dopa and its metabolites in rumen fluid, blood and the longisimuss dorsi muscle were measured at harvest. Lambs fed SB had greater ($P < 0.05$) ADG than those fed M (0.20 vs. 0.15 kg/d for RM; 0.18 vs. 0.13 kg/d for FN), and FN lambs had greater ($P < 0.01$) final BW (33.9 vs. 30.3 kg) and hot carcass weights (16.2 vs. 15.1 kg; ($P < 0.10$, tendency) than those fed M. However, supplementary protein source did not affect ($P > 0.05$) dressing percent and concentrations of BUN, blood glucose, cerruloplasmin, and haptoglobin, or concentrations of L-dopa and its metabolites in rumen fluid, blood and muscle. Therefore although SB is a better protein supplement than M, acceptable growth rates and carcass characteristics can be achieved with M supplementation in lambs. Mucuna L-dopa was extensively metabolized in lambs and did not elicit an inflammatory stress response or accumulate in muscle tissue. Therefore, feeding mucuna to lambs as described does not affect meat safety.

Key Words: *Mucuna pruriens* L-dopa, Soybean, Weight Gain

M306 Urea-nitrogen recycling in growing lambs fed diets differing in rumen degradable protein and carbohydrate. D. Kiran* and T. Mutsvangwa, *University of Saskatchewan*, *Saskatchewan, Canada*.

The objective of this study was to determine the interactions between dietary ruminally-degradable protein (RDP) level and ruminally-fermentable carbohydrate on urea kinetics and nitrogen efficiency in rapidly growing lambs fed high N diets. Four Suffolk ram lambs (34.8 ± 0.5 kg BW) were used in a 4 × 4 latin square design with 21-d periods and a 2 × 2 factorial arrangement of dietary treatments. The dietary factors studied were: 1) dry-rolled vs pelleted barley as the principal source of ruminally-fermentable carbohydrate; and 2) dietary levels of RDP of 60 vs 70%. All diets contained 28.8 g N/kg DM. Nitrogen balance was measured from d 15 to d 20, while urea-N kinetics were measured from d 15 to d 19 using intra-jugular infusions of [^{15}N^{15}N]urea. Nitrogen intake ($P = 0.001$), and fecal ($P = 0.002$) and urinary ($P = 0.034$) N excretion increased as the dietary RDP level increased; however, barley processing had no effect. Feeding dry-rolled barley compared to pelleted barley ($P = 0.04$), and feeding 60% RDP compared to 70% RDP ($P = 0.04$) resulted in higher N digestibility. Endogenous production of urea-N and its recycling to the gastrointestinal tract (GIT) did not differ among dietary treatments; however, endogenous production of urea-N was high (45.8 to 50.9 g/d), exceeding N intake (42.3 to 47.9 g/d) across dietary treatments. Similarly, across dietary treatments, 30.6 to 38.5 g/d of urea-N was recycled to the GIT, representing 66.9 to 74.2% of endogenous urea-N production; however, 63.6 to 75.6% of urea-N recycled to the GIT was returned to the ornithine cycle. In summary, although dietary treatment did not alter urea-N kinetics, substantial amounts of hepatic urea-N output were recycled to the GIT under the dietary conditions employed in this study, and additional research is required to determine how this recycled urea-N can be efficiently captured by bacteria within the GIT.

Key Words: Urea Recycling, Sheep, Degradable Protein

M307 Ruminal and intestinal protein and amino acid digestibility of feather meal and feather meal with blood products. K. W. Cotanch*[1], R. J. Grant[1], J. Darrah[1], M. E. VanAmburgh[2], D. A. Ross[2], and J. Haid[3], [1]*William H. Miner Agricultural Research Institute*, *Chazy, NY*, [2]*Cornell University*, *Ithaca, NY*, [3]*U.S. Poultry & Egg Association*, *Tucker, GA*.

Ruminal and intestinal protein and amino acid digestibility of feather meal (FM) with and without blood was determined using the 3-step in vitro procedure of Calsamiglia and Stern (1995) as modified by Gargallo et al. (1996). Thirteen samples of FM were selected for analysis: 6 without blood, 4 with blood added pre-hydrolyzation and 3 with blood added post-hydrolyzation. Hydrolyzation parameters varied

in time, (5 to 150 min), temperature (88 to 163°C) and pressure (30 to 75 psi). Samples were subjected to 12 and 18 h in situ (IS) incubation and 18 h in vitro (IV) incubation with rumen fluid buffer (Goering and Van Soest, 1970) comparing the 3 ruminal incubation methods. Ruminal residues were subjected to in vitro intestinal digestion with 0.1 N HCl and pepsin for 1 h, and then buffered pancreatin for 24 h. Residues were analyzed for total nitrogen (N) and essential amino acid (EAA). The GLM procedure of SAS was used to perform the ANOVA of the EAA content of the whole, buffer insoluble residue and undigested residues. Three soy products, a solvent-extracted soybean meal and two processed soy products were analyzed as controls with the FM through all procedures. Soy product N digestion was similar between products (98.2 to 99.3%) and among the IV intestinal digestion of the IS and IV ruminal residues. These values are consistent with previous data for these feeds and methods. Feather meal in vitro total N digestion did not significantly differ by product (P>0.05). Average total N digestibility for product without blood, with blood added pre-hydrolyzation and blood added post-hydrolyzation, were 57.6%, 64.1% and 66.6% respectively. These results support the 3-step methodology for protein and amino acid digestion as a viable means of estimating ruminal and intestinal digestion of FM product.

Key Words: Feather Meal, Digestibility, Protein

M308 Milk production, milk composition, digestion, and feed intake of cows fed different concentrations of flaxseed meal. H. V. Petit*[1] and P. S. Mir[2], [1]*Agriculture and Agri-Food Canada*, *Sherbrooke, QC, Canada*, [2]*Agriculture and Agri-Food Canada*, *Lethbridge, AB, Canada*.

Thirty-two lactating multiparous Holstein cows averaging 620 kg of BW were used from week 33 to 37 of lactation to determine the effects of different concentrations of flaxseed meal in the diet on milk production, milk composition, digestion, and feed intake. Cows were blocked for similar DIM. Cows within groups were assigned randomly to one of four treatments. The four TMR consisted of a control diet (CON) with no fat supplement or diets containing either 5, 10 or 15 % flaxseed meal (FM) on a DM basis. Diets were designed to yield similar CP and NEL concentrations. Diets were fed twice daily for 10% orts. Feed consumption and milk yield were recorded daily. Milk samples were obtained from each cow for two consecutive milkings on the fifth week of the experiment and they were analyzed separately to determine milk composition. Total collection of feces and urine was carried out on the fifth week of the experiment. Milk production averaged 22.0 kg/d and was similar among treatments. Milk concentrations of protein and fat, and yields of protein, lactose, and fat were not affected by diet. Intake of DM averaged 17.3 kg/d and was similar among treatments. Digestibilities of DM, ADF, NDF, and N were similar among treatments. Dietary concentrations of flaxseed meal had little effect on milk concentrations of fatty acids (FA). However, feeding FM increased milk concentrations of C18:3n3 and decreased the omega 6 to omega 3 FA ratio in milk fat. These results suggest that flaxseed meal is a good protein source for late lactating dairy cows and that it is possible to feed as much as 15% of the DM in the total diet with little effect on feed intake, milk yield and milk composition.

Key Words: Dairy Cow, Flaxseed, Fatty Acid

M309 Interactions between oilseed supplementation and barley grain processing on urea-nitrogen recycling and nitrogen metabolism in dairy cows. G. N. Gozho*, M. Hobin, and T. Mutsvangwa, *University of Saskatchewan*, *Saskatchewan, Canada*.

The objective of this study was to determine how interactions between oilseed supplementation and barley grain processing alter urea-N transfer to the gastrointestinal tract (GIT) and the utilization of this recycled urea-N in lactating dairy cows. Four Holstein cows (656.3 kg BW; 79.8 days-in-milk) were used in a 4 × 4 Latin square design with 21-d periods and a 2 × 2 factorial arrangement of dietary treatments. The dietary factors studied were: 1) dry-rolled or pelleted barley as the principal source of ruminally-fermentable carbohydrate; and 2) whole canola or whole flaxseed as supplemental fat sources, such that experimental diets contained 6% total fat. Nitrogen balance was measured from d 15 to d 19, while urea-N kinetics were measured from d 15 to d 19 using continuous intra-jugular infusions of [$^{15}N^{15}N$]urea. Nitrogen retention was unaffected (P > 0.05) by diet; however, fecal N excretion was higher (P < 0.001) in cows fed dry-rolled barley compared to those fed pelleted barley. Source of supplemental fat did not affect (P > 0.05) urea-N kinetics. Urea-N production (468.7 vs 371.4 g/d; P = 0.03) was higher, and urea-N entering the GIT (299.4 vs 239.9 g/d; P = 0.07) and the amount of GIT urea-N entry that was returned to the ornithine cycle (230.3 vs 189.6 g/d; P = 0.06) tended to be higher in cows fed dry rolled barley compared to those fed pelleted barley. Despite differences between cows fed dry-rolled barley or pelleted barley in the amounts of urea-N entering the GIT, the amounts of recycled urea-N that were used for anabolic purposes were similar (60.0 vs 42.8 g/d; P = 0.39). The proportion of endogenous urea-N production that was transferred to the GIT, and the proportion of urea-N GIT entry that was used for anabolic purposes, or was lost in the urine or feces were unaffected (P > 0.05) by diet. In consequence, even if barley grain processing altered endogenous urea-N production and urea-N entry into the GIT, this did not result in increased utilization of recycled urea-N for microbial production as the additional urea-N which entered the GIT was returned to ureagenesis.

Key Words: Dairy Cow, Urea Kinetics, Nitrogen Metabolism

M310 Influence of carbohydrate source on nitrogen metabolism and microbial protein synthesis in dairy cows. G. N. Gozho* and T. Mutsvangwa, *University of Saskatchewan*, *Saskatchewan, Canada*.

Nitrogen balance and microbial protein synthesis were examined in four ruminally-fistulated dairy cows (676.3 kg BW; 120.5 DIM). The experiment was a 4 × 4 Latin square design with 21-d periods during which TMR containing barley, corn, oats or wheat as the major carbohydrate source were fed. In western Canada, dairy cow diets typically contain barley, corn, wheat or oats as the principal source of energy, and these cereal grains differ in their starch content and in their ruminal starch degradation. Our hypothesis was that these cereal grains would differ in their ability to support ruminal microbial protein production. Dry matter intake was unaffected by diet; however, cows fed wheat tended (P = 0.08) to consume less DM compared to those fed barley, corn or oats. Milk yield was unaffected by diet; however, 3.5% fat-corrected milk yield for cows fed wheat was lower (P = 0.02) compared to cows fed barley, corn or oats. Total N intake, urinary N output, urinary urea-N output and N retention were all unaffected (P > 0.05) by diet. Cows fed oats tended (P = 0.09) to have a lower fecal N output compared to those fed wheat, barley or corn. Cows fed barley or

corn had higher N output in milk ($P = 0.03$) compared with those fed wheat or oats; however, when expressed as a percentage of N intake, milk N output averaged 25% and was unaffected by diet. Overall, N balance was not affected ($P = 0.10$) by diet. Urinary uric acid excretion was unaffected by diet, but urinary allantoin excretion tended ($P = 0.08$) to be higher in cows fed barley or corn compared to those fed wheat or oats. Urinary excretion of purine derivatives (PD; uric acid + allantoin) were higher ($P = 0.04$) in cows fed barley (436 mmol/d) or corn (427 mmol/d) compared to those fed wheat (397 mmol/d) or oats (379 mmol /d). Microbial protein synthesis, calculated from PD excretion, was higher ($P = 04$) for cows fed barley (324 g N/d) compared to those fed wheat (291 g N/d) or oats (275 g N/d). These data suggest that commonly-fed carbohydrate sources differ in their ability to support ruminal microbial protein production.

Key Words: Dairy Cow, Nitrogen Metabolism, Microbial Protein Synthesis

M311 Supplementation of lactating cows receiving high citrus pulp diets with heated soybeans. G. S. Dias Júnior[1], A. van Vugt[2], G. Warringa[2], C. A. Mello, Jr.[3], and M. N. Pereira*[1], [1]*Universidade Federal de Lavras*, *Brazil*, [2]*Wageningen University*, *Holland*, [3]*Nutron Alimentos*, *Brazil*.

Total or partial replacement of corn by citrus pulp has decreased milk protein production. We tried two strategies to avoid such a depression: Increasing diet RUP content by replacing raw soybeans by heated soybeans, and decreasing diet forage content by replacement of corn silage by pellets of citrus pulp. Twenty-one Holsteins were assigned to a sequence of three treatments in seven 3x3 Latin Squares with 21-day periods. All diets contained 10.7% of DM of mature and finely ground flint corn, 13.0% of soybean meal and 11.0% of whole soybeans. Diet corn silage content was 46.9% for the high forage treatments with heated (HFHS) or raw (HFRS) soybeans. The low forage diet contained 34.2% of corn silage and raw soybeans (LFRS). Two single degree of freedom orthogonal contrasts were tested: LFRS *vs.* HFRS and HFRS *vs*. HFHS. Nutrient composition of the consumed diets were: 16.4% CP, 33.1% NDF, 19.3% forage NDF, and 5.1% EE for LFRS; 15.9% CP, 36.4% NDF, 26.6% forage NDF, and 5.1% EE for HFRS; and 16.6% CP, 37.3% NDF, 26.4% forage NDF, and 5.3% EE for HFHS. Intake was 17.6 ($P<0.01$), 19.1 and 19.5 ($P=0.51$) kg/d for LFRS, HFRS and HFHS. Milk yield was increased from 29.1 kg/d to 30.2 when heated soybeans replaced raw soybeans ($P=0.06$), while the replacement of forage with byproduct was not so effective (29.8, $P=0.18$). Lactose secretion were (kg/d): 1.364 for LFRS ($P=0.09$), 1.330 for HFRS, and 1.391 for HFHS ($P=0.03$). Plasma glucose were: 52.5 ($P=0.08$), 54.8 and 51.4 ($P=0.01$) mg/dl for LFRS, HFRS and HFHS. Diets that increased lactose secretion, decreased plasma glucose. Dietary manipulation did not affect the daily secretion or the content of fat and protein in milk ($P>0.22$). Diet LFRS had greater secretion of milk energy per unit of digestible organic matter intake than diet HFRS (1.53 vs. 1.49 Mcal/kg, $P=0.06$). Chewing time was decreased by the low forage diet ($P<0.01$), but plasma lactate did not change ($P>0.20$). Substitution of raw by heat treated soybeans increased milk yield and had no effect on milk composition, the mechanism may have involved a larger drive of plasma glucose to milk lactose synthesis.

Funded by Nutron/Provimi

Key Words: Lactose, Glucose, Milk Solids

M312 Comparison of protein disappearance of alfalfa hay and barley grain by *in vivo*, mobile bag and 3-step methods. H. Jahani-Azizabadi, M. Danesh Mesgaran*, R. Valizadeh, and H. Nasirimoghadam, *Ferdowsi University of Mashhad*, *Mashhad, Iran*.

Ruminal, post-ruminal and total tract crude protein (CP) disappearance of alfalfa hay and barley grain were measured using in vivo, mobile bag and three-step *in situ* / *in vitro* enzyme procedures. For in vivo, eight Baluchi lambs (49.4 ± 3.5 kg, body weight) were used. Experimental diets were made of two alfalfa hay:barley grain ratios (DM basis) as 1.0:0.0 and 0.50:0.50. Diets were fed to animals for 28 d, with 7 d of feces collection. For the mobile nylon bag technique, two Holstein steers (450 ± 50 kg, body weight) fitted with ruminal fistulae and T-shaped intestinal cannulae were used. Steers fed 5.1 kg of alfalfa hay, 1.2 kg of corn silage and 2.7 kg of concentrate (150 CP/kg of DM). Three-step procedure was followed by rumen incubation of samples for 12 h and enzymatic incubation of ruminal-undegradable samples. Data were analyzed using completely block randomized design. In vivo total tract CP disappearance of alfalfa hay and barley grain (0.74 and 0.69, respectively) was significantly ($P< 0.01$) lower than in situ mobile nylon bag (0.89 and 0.96, respectively) and three-step procedure (0.81 and 0.89, respectively). Total tract CP disappearance from mobile nylon bag was significantly ($P< 0.01$) higher than three-step technique. Post-ruminal disappearance of ruminal undegradable CP from alfalfa and barley grain in the mobile nylon bag method (0.69 and 0.86, respectively) was significantly ($P< 0.01$) higher than the three-step enzymatic method (0.49 and 0.56, respectively). Results of the present study showed that there is significant difference between in vivo, mobile bag and the 3-step method when total tract CP disappearance of barley grain and alfalfa hay is evaluated.

Key Words: Protein, Three-Step Procedure, Mobile Bag

M313 Evaluation of a rumen undegradable soybean product for lactating dairy cattle. S. S. Donkin*[1], S. L. Koser[1], E. M. Barnes[1], P. H. Doane[2], J. L. Dunn[2], and M. J. Cecava[2], [1]*Purdue University*, *West Lafayette, IN*, [2]*ADM Animal Nutrition Research*, *Decatur, IN*.

Increasing the bypass protein content of soybean meal can be accomplished by applying moist heat and additives in a controlled reaction process. The objective of this study was to determine the effects of feeding a specially-processed high bypass soybean meal on performance of dairy cows. Thirty-six multiparous Holstein cows from the Purdue University Dairy Cattle Research and Education Center were used in the study. Cows were 123 ± 4 days and produced 37.2 ± 1.1 kg/d of milk at study initiation. The base diet consisting of corn silage, legume haylage, legume hay, cottonseed hulls, soyhulls, soybean meal, corn gluten meal, high moisture corn, and a mineral/vitamin supplement was fed during a two-week covariate adjustment period. During the following six weeks, cows were fed the diets containing soybean meal (Negative control; NC), Aminoplus® to replace soybean meal and increase dietary RUP content (Positive control; PC), or the specially-processed bypass soybean meal as a replacement for soybean meal (RUPSBM). All diets contained equal amounts of protein and the PC and RUPSBM diets contained equal quantities of RUP. Cows were milked twice daily and weekly milk samples were analyzed for fat, protein, lactose, total solids, milk urea N, and somatic cells. Body weights and body condition scores were obtained at the beginning and the end of the study. Milk production was 37.4, 36.6, 37.8 ± 1.7 kg/d and feed intake was 25.6, 25.8, 26.3 ± 0.7 kg/d for NC, PC, and RUPSBM, respectively, and did not differ ($P > 0.05$). Milk composition

was not affected by treatment. When averaged across all treatments, DMI was 25.9 kg/d, or approximately 4.3% of body weight. The high DM and consequent high RUP intake likely diminished the ability to determine the value of bypass protein for lactating dairy cows. Both AminoPlus and RUPSBM were acceptable for lactating dairy cow diets based upon no observed detrimental effects on feed intake and milk yield or milk composition.

Key Words: Rumen Undegradable, Protein, Dairy

M314 The effects of controlled feeding a high concentrate or high forage diet at four nitrogen intakes on digestibility in dairy heifers. G. I. Zanton* and A. J. Heinrichs, *The Pennsylvania State University*, *University Park*.

The hypothesis of this experiment is that a high concentrate ration (**HC**) will be utilized with a greater efficiency than a high forage ration (**HF**) by postpubertal dairy heifers and that the response will be affected by level of N intake. To test this hypothesis, 8 Holstein heifers (beginning at 362 ± 7 kg and 12.3 ± 0.4 mo) were fed eight rations according to a split-plot, 4 x 4 Latin square design. Treatments were formulated to contain 75% or 25% forage (corn silage and chopped wheat straw) and 4 levels of N intake (0.94, 1.62, 2.30, 2.96 g N/kg $BW^{0.75}$ per d) and were fed to maintain equal ME intake. Feces were collected for 8 d/ 28 d period. Organic matter intake was greater for heifers fed HF, but, due to increased OM digestibility of HC (74.0 vs 67.6% ± 0.9; $P < 0.001$), digestible OMI was unaffected by forage level ($P > 0.40$). OM digestibility was affected by an interaction between forage level and N intake ($P < 0.013$); increasing to a plateau of 77.5% at 2.30 g N/kg BW0.75 for HC and 69.0% at 1.62 g N/kg $BW^{0.75}$ per d for HF fed heifers. Apparent N digestibility was greater for heifers fed HC and increased from 47.7% to 80.8% between 0.94 and 2.96 g N/kg $BW^{0.75}$ per d. Analysis of covariance revealed a strong linear relationship between apparently digested N and N intake, however the response differed between forage levels ($P < 0.05$). Predicted true digestibilities were 97.4 and 94.4% and non-dietary fecal N excretion was 0.45 and 0.47 g N/kg $BW^{0.75}$ per d for HC and HF fed heifers, respectively. Due to these relationships, less N appeared in the feces of heifers fed HC than HF (0.50 vs 0.57 g N/kg $BW^{0.75}$ per d). It is concluded that increasing N intake increases the digestibility of OM, the magnitude of which depends on the level of dietary forage provided. It is further concluded that the digestion of N by dairy heifers is high and nearly complete and that the majority of N appearing in the feces is not of dietary origin and may be differentially affected by the level of forage intake.

Key Words: Dairy Heifer, Forage:Concentrate, N Intake

M315 Evaluation of the fermentation dynamics of the soluble protein fraction of three protein sources in continuous culture fermenters. M. Ruiz Moreno*[1], A. Bach[2,3], M. Thrune[1], and M. D. Stern[1], [1]*University of Minnesota*, *Saint Paul*, [2]*ICREA*, *Barcelona, Spain*, [3]*IRTA-Unitat de Remugants*, *Barcelona, Spain*.

Six dual-flow continuous culture fermenters were used to assess differences in degradation pattern and ability to promote bacterial growth from the soluble CP fractions of canola meal (CM), soybean meal (SBM) and fish meal (FM) using a completely randomized design with two 9-d experimental periods. All fermenters received the same basal diet (58% ground corn, 40% canary grass hay, 0.4% vitamin-mineral premix, 1% CaCO3, 0.6% salt on a DM basis). During sampling on the last 3-d of each period, 90-mL doses containing soluble proteins were infused into fermenters 30 min after the beginning of the first and last feedings of the day at a rate of 3 mL/min, using a constant-infusion pump. These doses were prepared from samples of FM, SBM and CM that were ground and soaked in distilled water (1:4 wt/vol, 38C, 1h) under continuous stirring. The solutions were centrifuged and the supernatant vacuum-filtered through a N-free filter paper. Equal N concentrations were achieved by diluting filtrates with the higher N content to match the one with the lowest N content using distilled water. Normalized filtrates (1.8% CP as is) were frozen in 90-mL doses and were gently thawed prior to infusions into the fermenters. The total amount of soluble CP supplied by the infusions of FM, CM and SBM was 3.2 g/d, representing 27% of daily dietary CP intake. Each sampling day at 0, 0.5, 1, 3, and 6 h following the morning infusion of soluble CP fractions, a 10-mL aliquot from each fermenter flask was collected to determine NH_3-N concentrations. Infusion of FM resulted in the greatest ($P < 0.05$) NH_3-N concentrations (4.5±0.08 mg/dL) compared with the other treatments (0.42±0.08 mg/dL). Bacterial N flow (g/d) was also greatest ($P < 0.05$) with FM (1.47±0.07) compared with the other soluble CP fractions (1.09±0.07). Results indicate that microbial degradation of the soluble CP fraction of FM appears to be higher than the soluble CP fractions of CM or SBM.

Key Words: Soluble Protein, Rumen, Dual Flow Fermenters

M316 Supplementation of grazing dairy cows with high-fat dietary protein sources. R. Nyoka*, A. R. Hippen, and K. F. Kalscheur, *South Dakota State University*, *Brookings*.

The effect of supplementing cows on pasture with partial Total Mixed Rations (pTMR) containing different high-fat protein sources on milk yield and milk components was investigated. The objective of the experiment was to investigate the effect of using distiller's grains, soybean meal, and fishmeal as supplements to cows grazing an alfalfa/grass pasture on milk yields and milk components. Multiparious Holstein (n = 18) and Brown Swiss (n = 9) cows were blocked by milk yield and assigned to three dietary treatments in a complete randomized design for an 8 wk experimental period. The first 2 wk were a covariate period in which all 27 cows were fed a common diet. After the covariate period, nine cows in each dietary treatment were fed Soybean (SB), Fishmeal (FM), or Dry Distillers grain (DDG) in a partial TMR. The partial TMR was fed in the morning at a rate to provide 50% of estimated energy intake determined during the covariate period and cows grazed ad libitum on alfalfa pasture from the afternoon till the morning milking. Milk was sampled at all three milkings each day on the last 2 d of the covariate period, every third day during the first 9 d of the grazing period, and the last day of each week for 6 wk. There were no significant ($P > 0.05$) dietary effects observed in milk yield and milk components. Significant ($P < 0.05$) time differences were observed in milk yield and milk MUN content. Significant time*diet interactions ($P < 0.01$) were observed in milk yield with the decline in milk yield greatest in FM followed by DDG and the least in SB based TMR (40%, 34%, and 29% respectively). This research demonstrated that soybean-based supplement supports greater milk production in grazing cows than the lesser ruminally degradable protein sources distillers grains and fish meal.

Key Words: High Protein Diet, High Fat Diet, Grazing

M317 Effects of pure essential oil compounds on the digestion of nitrogen in dairy cows. V. Noirot[1] and C. Bayourthe*[2], [1]*Phodé, Albi, France*, [2]*Ecole Nationale Supérieure d'Agronomie de Toulouse, Castanet-Tolosan, France*.

An *in vivo* study was carried out to evaluate the effect of oral pure essential oil compounds (EOc) on nitrogen (N) digestion. Four non-lactating cows with ruminal, duodenal and ileal cannulas were used in a 4 × 4 Latin square design. EOc was given daily in two equal doses at feeding times with a total dose of either 1 g / head for carvacrol (Cv) and cinnamaldehyde (Cn) or 2 g / head for Cv + Cn (1:1). Each experimental period lasted 21 days, including 14 days of adjustment and 7 days of collection. There was a 3-day interval between two experimental periods during which all the cows received the control (C) diet to return them to the initial state. The markers Cr-EDTA, $YbCl_3$ and purines were used for liquid, particulate matter, and bacteria, respectively. Effects of treatments were determined (PROC MIXED, SPSS) and orthogonal contrasts were used: (C + Cn) *vs* (Cv + [Cv + Cn]). Significance was declared at $P \leq 0.05$ and tendency at $P \leq 0.10$. Compared with C and Cn, Cv and Cv + Cn increased significantly passage of non ammonia N (NAN) to the small intestine (159.8 *vs* 146.4 g / d) and duodenal N (percentage of NAN) of bacterial origin (64.3 *vs* 56.2 %). They also tended to slightly increase the apparent ruminal digestion of feed N ($P = 0.08$) compared with C and Cn. Bacterial synthesis efficiency was significantly improved by Cv treatments (16.6 *vs* 13.9 g N / kg of OM truly digested in the rumen).

Table 1.

	Treatment					P	
	C	Cn	Cv	Cv + Cn	SEM	Treatment	C+Cn *vs* Cv+ [Cv+Cn]
N Intake, g/d	163.0	164.9	166.7	165.2	2.1	0.80	-
Duodenal flow, g/d							
Total N	159.5	160.2	175.6	177.5	5.2	0.05	0.01
Nonammonia N	145.2	147.6	160.6	159.0	5.5	0.18	0.04
Bacterial N	79.7	84.9	101.7	103.8	4.4	< 0.001	< 0.001
Feed N apparent digestion, %	60.2	62.1	64.2	66.4	2.1	0.25	0.08
Microbial synthesis, g N / kg OMTDR	13.5	14.2	16.9	16.3	0.7	0.002	< 0.001

Key Words: Dairy Cow, Essential Oil Compound, Nitrogen

M318 Effects of garlic and juniper berry essential oils on site and extent of digestion by dairy cows. W. Z. Yang*[1], C. Benchaar[2], A. V. Chaves[1], M. L. He[1], and T. A. McAllister[1], [1]*Research Centre, Agriculture and Agri-Food Canada, Lethbridge, AB, Canada*, [2]*Dairy and Swine R&D Centre, Agriculture and Agri-Food Canada, Lennoxville, QC, Canada*.

An experiment was conducted to evaluate the effects of garlic (GAR) and juniper berry (JUN) essential oils (EO) and monensin (MO) on feed intake, site and extent of digestion, and microbial N synthesis in the rumen. Four mid-lactating Holstein cows with ruminal and duodenal cannulas were used in a 4 × 4 Latin square design (21-d periods) with four treatments: control (no additives), GAR (5 g/cow/d), JUN (2 g/cow/d) and MO (330 mg/cow/d). Cows were fed ad libitum a TMR consisting of 40% forage and 60% barley-based concentrate. Data were analyzed using the PROC MIXED procedure of SAS to account for effects of period, cow and treatments (feed additives). Feed intake averaged 20.4 kg/d and was not affected by the dietary additives. Digestibilities of DM and OM in the rumen were similar between GAR and JUN supplementation, and were increased by 13% ($P < 0.02$) compared to the control and MO. This increase was mainly attributed to the increase in ruminal CP ($P < 0.03$) and starch ($P < 0.15$) digestion. However, GAR and JUN supplementation had no effects ($P > 0.15$) on total-tract digestibilities of DM, OM, NDF, starch and CP. Supplementation of MO reduced ruminal digestibilities of CP (-11%; $P < 0.03$) and NDF (-16%; $P < 0.15$) compared with the control, but did not alter the total digestibility of other nutrients. Flow (g/d) of microbial N to the duodenum was similar ($P > 0.15$) among treatments, whereas the proportion of microbial N in the duodenum (% of intake) was higher ($P < 0.09$) for GAR and JUN (59.8%) than for the control (46.6%) or the MO (47.1%). These results suggest that at the doses evaluated, supplementing dairy cows with GAR and JUN had potential to improve feed digestibility in the rumen but not in the total tract.

Key Words: Essential Cil, Digestion, Dairy Cow

M319 Effect of vegetal extracts on rumen microbial fermentation in batch culture. M. Ruiz Moreno*[1], A. Bach[2,3], J. van Eys[4], and M. D. Stern[1], [1]*University of Minnesota, Saint Paul*, [2]*ICREA, Barcelona, Spain*, [3]*IRTA-Unitat de Remugants, Barcelona, Spain*, [4]*Global Animal Nutrition, Paris, France*.

An experiment using 24 h batch culture incubations was conducted in two consecutive periods to evaluate the effect of four different vegetal extracts on rumen microbial fermentation. Treatments consisted of 300 mg of *Acacia concinna* (AC), *Sapindus mukorossi* (SM), *Yucca schidigera* (YS) or *Sapindus rarak* (SR) extracts, added to 500 mL sealed bottles. An additional set of bottles without vegetal extract was utilized as a control (C) group. Each treatment was randomly assigned in triplicate to the incubation bottles. Three grams of DM (60% forage: 40% concentrate) were provided as substrate for microbial fermentation. Three hundred mL of a 1:4 rumen fluid + buffer mix were anaerobically transferred to each bottle and incubated in an agitation bath at 39 C. At each of the following incubation times, 0, 3, 6, 9, 12 and 24 h, gas pressure was monitored using a digital pressure meter, pH was recorded, and a 10 mL aliquot was anaerobically removed for ammonia and VFA analyses. Cumulative pressure throughout the experiment was calculated by adding individual pressures. Results were analyzed as repeated measures using mixed model by SAS. The control group had a higher pH ($P < 0.05$) than the rest of the treatments (C=6.63; vs SM=6.57; AC=6.58; SR=6.59; YS=6.6). There was a trend ($P < 0.1$) for pH with YS to be higher compared with SM. The SR and YS treatments attained lower ($P < 0.05$) ammonia concentrations (21.4 and 21.3 mg/100 mL, respectively) compared with C (22.6 mg/100 mL), AC (22.2 mg/100 mL) and SM (22.3 mg/100 mL) treatments. No differences in cumulative gas pressure were obtained between treatments ($P > 0.05$). Lower ammonia release after the addition of SR and YS extracts suggests a beneficial use of these extracts in altering ruminal protein degradability.

Key Words: Vegetal Extracts, Rumen, Batch Culture

M320 Adding rare earth elements to beef cattle diets improved in situ digestibility in the rumen and digestibility in the total tract. Q. Liu[1], W. Z. Yang*[2], C. Wang[1], Y. X. Huang[1], K. H. Dong[1], and H.

Wang[1], [1]*College of Animal Sciences and Veterinary Medicines, Shanxi Agricultural University*, *Taigu, Shanxi, China*, [2]*Research Centre, Agriculture and Agri-Food Canada*, *Lethbridge, AB, Canada*.

Rare earth elements have been used as feed additives for many years in China and recently shown to improve growth performance of pig in Europe. A study was conducted to evaluate the effects of addition of Lanthanum (La) to beef cattle diet on in situ ruminal degradation and digestibility in the total tract. Eight ruminally cannulated steers were used in a replicated 4 × 4 Latin square experiment. Treatments were control, low, medium and high dose of La with 0, 450, 900 and 1800 mg/steer/day $LaCI_3$, respectively. Diets consisted of 60% corn straw and 40% concentrate (DM basis). Corn straw and soybean meal were ground (2-mm) and measured for in situ ruminal digestibility. The duplicated bags were suspended in the rumen of each steer for 0, 4, 8, 12, 24, 36, 48 and 72 h. Increasing the dose of La quadratically ($P < 0.02$) increased ruminal soluble (0.11, 0.19, 0.27 and 0.12) and potential degradable fractions (0.70, 0.72, 0.73 and 0.88), and effective degradability (ED; 39.9, 40.1, 42.1 and 30.3% for control, low, med and high dose of La, respectively) of DM for corn straw. The soluble fraction (0.44, 0.42, 0.42 and 0.38) and ED (58.3, 56.9, 55.0 and 51.3%) of DM were linearly ($P < 0.01$) decreased but the potential degradable fraction (0.52, 0.52, 0.56 and 0.60 for control, low, med and high dose of La, respectively) was linearly ($P < 0.04$) increased with increasing La supplementation for soybean meal,. Digestibilities of OM (72.1, 75.0, 77.9 and 74.5%), NDF (59.4, 62.6, 67.2 and 63.1%) and CP (72.1, 76.2, 77.3 and 75.4% for control, low, med and high dose of La, respectively) in the total tract were quadratically improved ($P < 0.05$). These results indicate that $LaCI_3$ supplementation potentially improved digestibility in the rumen and in the total tract of beef cattle with a dose-dependent manner.

Key Words: Rare Earth Elements, Digestibility, Beef Cattle

M321 Ethanolic extract of propolis in lactating cows. J. A. De Freitas*[1], J. C. De Souza[1], R. P. Lana[2], R. P. Antonangelo[1], A. A. De Freitas[2], and R. T. S. De Santana[1], [1]*Federal University of Parana*, *Palotina, PR, Brazil*, [2]*Federal University of Viçosa*, *Viçosa, MG, Brazil*.

Propolis is a natural product that contains several powerful substances like the flavonoids which have important therapeutic properties. Propolis also seems to have effects upon the rumen bacterial membrane and can be considered as ionophore agent. This study aimed to evaluated the effect of ethanolic extract of propolis (EEP) upon milk and 4% fat corrected milk (FCM) production, milk fat and milk protein in dairy cows. The research was conducted in Federal University of Parana - Brazil. Twenty Holstein cows with an average weight of 600 kg and production of 6000 kg of milk/year were used. The animals were fed ad libitum a diet formulated using the 2001 dairy NRC recommendations. The experiment was analyzed as completely randomized design and two treatments, with 10 animals per treatment, were used: T1 - control treatment - the animals were fed ad libitum a diet formulated to supply energy, protein, minerals and vitamins requirements plus 100 gr of finely ground corn; and T2 - T1 plus 50 mL of 30% EEP. The data were submitted to the analysis of variance and means of treatments were compared at 5% probability. The addition of EEP resulted in increased milk production but did not influence FCM (Table 1). Propolis probably acts upon the Gram-positive bacteria, reducing their growth and methane production, thereby reducing loss of energy in the rumen and increasing the total available energy for metabolism. Milk fat and protein were greater (3.14 vs 3.03 and 2.93 vs 2.80, respectively) in the treatment with EEP addition.

Table 1. Effect of propolis addition upon milk and 4% FCM production

Treatment	Milk (kg/cow/day)	Standard error	4% FCM (kg/cow/day)	Standard error
1 – Control	22.63a	1.30	19.48 ns	1.21
2 – EEP	25.92b	0.91	22.20 ns	0.85

ns – non significative ($p>0.05$).

Key Words: Animal Nutrition, Performance, Ruminal Fermentation

M322 Ruminal bacterial diversity in cattle grazing wheat and supplemented with condensed tannins. B. R. Min*[1], W. E. Pinchak[1], M. E. Hume[2], and R. C. Anderson[2], [1]*Texas Agricultural Research Center*, *Vernon, TX*, [2]*USDA/ARS, Food and Feed Safety Research Unit*, *College Station, TX*.

The objectives of this study were to 1) ascertain relative changes in ruminal bacterial diversity associated with transition from a Bermuda grass hay to a grazed wheat diet, 2) determine relative changes in diversity over 90 days of grazing winter wheat, and 3) bacterial populations response to supplementation with condensed tannin (CT) through the developmental stages of wheat associated peak bloat risk in stocker cattle. Eighteen rumen-cannulated steers were randomly allocated to CT treatments (0, 10, and 20 g CT/kg dry matter intake). Ruminal bacterial diversities were visualized by polymerization chain reaction (PCR)-denaturing gel gradient electrophoresis (DGGE). Dendograms were constructed based on similarity coefficients (% SC) among bands patterns. On day - 30, after steers had been fed Bermuda grass hay for 30 days, ruminal bacterial populations clustered ranging from 82 to 96% SC and exhibited animal to animal variation. Following 30 days (referred as to day 0) adaptation to grazing wheat, variability in bacterial populations within and among animals increased from 68 to 92%. After day 20 day CT supplementation and 50 days grazing wheat, ruminal bacterial similarity (83 to 98% SC) was comparable (82 to 92% SC) to day 0. In contrast, CT supplementation caused ruminal bacterial populations to become more dissimilar (56 to 84% SC). These results clearly document changes in ruminal bacterial populations associated with wheat grazing, animal to animal variation, and CT supplementation over time. The results of this study suggest that molecular-based DGGE facilitated rapid and cost effective visualization of diverse in vivo ruminal bacterial communities among animals, between diets and through time

Key Words: Bacterial Population, Plant Tannins, Wheat Forage

M323 *In vitro* manipulation of rumen fermentation by propolis flavonoids and monensin. S. M. J. Yaghoubi*[1], G. R. Ghorbani[1], H. R. Rahmani[1], and A. Nikkhah[2], [1]*Isfahan University of Technology*, *Isfahan, Iran*, [2]*University of Manitoba*, *Winnipeg, MB, Canada*.

Human health concerns as to the use of ionophore antibiotics in ruminant diets have promoted research on natural plant extracts. Flavonoids are plant pigments comprising polyphenolic compounds

with antimicrobial activity. The primary objective was to determine the effects of 1) the flavonoid extract from propolis (FE) and 2) monensin (MO) on batch culture rumen fermentation in three experiments. The three *in vitro* experiments determined fermentation properties of three diets with forage to concentrate ratios of 1) 100:0, 2) 50:50, or 3) 20:80. Rumen fluid was collected from two fistulated Naeini sheep fed for maintenance and adapted for 14-d to the same diet used as the substrate during the in vitro experiment. The FE doses of 17, 35, 70, and 140 µg/ml and a MO dose of 2.5 µg/ml were added to the three cultures (i.e., three forage to concentrate ratios). Within each forage to concentrate ratio, there was a control culture with no FE and MO. The increasing levels of FE linearly reduced ($P < 0.05$) in vitro 24-h dry matter disappearance in the 50% and 100% forage cultures but increased it in the 20% forage culture. The in vitro ADF disappearance, gas production, and ammonia concentrations were also decreased ($P < 0.05$) by the increasing levels of FE. Both FE and MO decreased pH with 20% but not with 50% dietary forage. With 20% and 50% forages, MO decreased ($P < 0.05$) ammonia and gas production. Also, MO reduced ($P < 0.05$) ADF digestibility with 20% and 100% forages but not with 50% forage culture. Monensin, however, increased ($P < 0.05$) 24-h dry matter digestibility with 20 and 50% but not with 100% dietary forage. The protozoa populations were decreased ($P < 0.05$) by MO and in a dose-dependent manner by FE with 50% and 20% forage diets. Results demonstrated that FE can manipulate the batch culture rumen fermentation. The effects of FE on rumen fermentation were reasonably comparable to that of MO. Therefore, findings offer the perspective that FE may be considered as an alternative for MO. Future in vitro and in vivo studies are essential before such a perspective could turn into an on-farm potential.

Key Words: Batch Culture, Flavonoid, Propolis

M324 Effects of zeolites and monensin on *in vitro* dry matter disappearance, pH change, and volatile fatty acid proportions. B. F. Domeniconi*[1,2], J. P. McMeniman[1], J. T. Vasconcelos[1], and M. L. Galyean[1], [1]*Texas Tech University*, *Lubbock*, [2]*FMVZ-UNESP*, *Botucatu, Brazil*.

Two experiments were conduced to determine the effects of 2 different zeolites and monensin on IVDMD and VFA proportions (Exp. 1) and in vitro pH changes over time measured with a reduced buffer fermentation (Exp. 2) of a 90% concentrate diet. Dietary treatments in both experiments were: 1) biolite (BIO); 2) maxibond (MAX); 3) monensin (MON); and 4) control (CON). All products were included in a 90% concentrate steam-flaked corn-based diet. The BIO and MAX additives were included at 2% of DM, and the MON and CON diets contained 2% (DM basis) of an inert substance (sand). Monensin was added to the cultures in 100 µL of ethanol to provide 4 µg/mL of culture, with an equal volume of ethanol added to other cultures. For Exp. 1, diet substrates (approximately 0.5 g in duplicate) were incubated with 35 mL of a 4:1 McDougall's buffer-to-ruminal fluid mixture for 0, 2, 4, 8, 24, and 36 h at 39°C, followed by a 48-h incubation in acidified pepsin solution. For Exp. 2, the same procedures were followed, except that the McDougall's buffer was diluted to 25% strength with 0.9% (wt/vol) saline, and culture pH was measured with a combination electrode at 0, 0.5, 2, 4, 8, 12, and 24 h. Ruminal fluid was obtained approximately 4 h after feeding from 2 ruminally cannulated steers fed a 75% concentrate diet. Both experiments were replicated in 2 separate runs. The IVDMD differed only at 8 h of incubation, being greater for MON than for BIO ($P = 0.03$) and MAX ($P = 0.02$). No differences ($P > 0.10$) in pH at the various incubation times were observed among treatments. For VFA in culture fluid after the 36-h incubation period of Exp. 1, MON increased propionate compared with MAX ($P = 0.01$) and BIO ($P = 0.03$), whereas proportions of acetate were greater for MAX ($P = 0.01$) and BIO ($P = 0.05$) than for MON. No differences in VFA proportions were observed between the 3 treatments and CON for either acetate ($P = 0.43$) or propionate ($P = 0.84$). Data suggest that adding 2% of these 2 zeolites to a high-concentrate diet did not markedly alter IVDMD or changes in pH compared with monensin, but both zeolites increased acetate relative to monensin.

Key Words: IVDMD, Monensin, Zeolites

M325 Preservation of enzymatic activities in a liquid extract obtained after *Agaricus bisporus* growth. M. Ayala–Martínez[1], S. S. González*[2], G. D. Mendoza–Martínez[3], C. Vázquez–González[1], M. Meneses–Mayo[2], O. Loera[4], and J. H. Avellaneda–Cevallos[5], [1]*UNAM*, *México D.F.*, [2]*Colegio de Postgraduados*, *Montecillo, Edo. México, México*, [3]*UAM Xochimilco*, *México D.F.*, [4]*UAM Iztapalapa*, *México D.F.*, [5]*Universidad Tecnica Estatal de Quevedo*, *Quevedo, Ecuador*.

The objective of this study was to evaluate lignocellulolytic enzymes and soluble protein in a crude extract from a compost after harvesting *Agaricus bisporus* body fruits at 50, 60 and 90 days culture times. Then crude extract was subjected to preservation treatments: refrigeration (R); R + benzoic acid (RB); freezing (F); F + B (FB); F + glycerol (FG); F + G + B (FGB); liophilization (L). Residual enzymatic activities were measured at 1, 7, 14, 28, 56 and 101 days after preservation. The experimental design was completely randomized, an ANOVA was performed and means were compared with Tukey test ($P \leq 0.01$). A difference ($P \leq 0.01$) was found according to culture times (50, 60 and 90 days) for xylanases (4361a, 3124b, 587c IU/g), cellulases (17b, 25a, 9c IU/g|), laccases (2502b, 3279ab, 4657a IU/g) and soluble protein (0.62a, 0.64a, 0.41b mg/g), with the highest values at 50 and 60 days. For conservation treatments the best results were for FB for xylanases (1323 IU/g), F for cellulases (9.09 IU/g), FG for laccases (3714 IU/g), and FB for soluble protein (0.75 mg/g).

Key Words: Fibrolytic Enzymes, Preservation Methods, *Agaricus Bisporus*

M326 Activity of fibrolytic enzymes by *Trametes sp.* EUM1, *Pleurotus ostreatus* IE8 and *Aspergillus niger* AD96.4 in solid-state fermentation. A. T. Márquez-Araque[1], G. D. Mendoza-Martínez[2], S. S. González*[3], S. E. Buntinx-Dios[4], and O. Loera[5], [1]*UNAM and UCLA*, *México D.F. and Caracas, Venezuela*, [2]*UAM Xochimilco*, *México D.F.*, [3]*Colegio de Postgraduados*, *Montecillo, Edo. México, México*, [4]*UNAM*, *México D.F.*, [5]*UAM Iztapalapa*, *México D.F.*

The objective of this study was to determine the activity of fibrolytic enzymes (xylanases, celullases and laccases) from the fungi *Trametes sp.* EUM1, *Pleurotus ostreatus* IE8, and *Aspergillus niger* AD96.4 at 14 and 19 d of fermentation on sugar cane bagasse. The fibrolytic activity was expressed as IU/g DM and as specific activity (IU/mg protein). The experimental design was completely randomized with four replicates per treatment, and means were compared with Tukey test ($P \leq 0.01$). *Trametes sp.* EUM1 showed higher activity ($P \leq 0.01$) of xylanases (141.77 IU/g DM and 1073.8 IU/mg protein) and celullases

(9.04 IU/g DM and 69.16 IU/mg protein) as compared to *P. ostreatus* IE8 and *A. niger* AD96.4. The higher (P≤0.01) laccases activity was expressed by *P. ostreatus* IE8 (15.54 IU/g DM and 128.75 IU/mg protein) at 14 and 19 d (11.75 IU/g DM and 102.88 IU/mg protein). For *Trametes sp*. EUM1 the laccases activity was similar at both fermentation times (3.45 and 2.03 IU/g DM) and lower (P≤0.01) than *P. ostreatus* IE8. For *A. niger* AD96.4 the laccases activity was significantly low. The activity of fibrolytic enzymes by *Trametes sp.* EUM1 suggests a potential for biotechnological applications in ruminant nutrition.

Key Words: Fungus, Fibrolytic Enzymes, Times of Fermentation

M327 Feed intake, nutrient digestibility and animal growth performance in sheep and goats fed wheat straw *ad lib*. in presence of ZADO as direct feed of anaerobic enzymes and bacteria. A.-F. Salem*[1], M. El-Adawy[1], H. Gado[2], and M. Khalil[3], [1]*Department of Animal Production*, *Faculty of Agriculture (El-Shatby), Alexandria University, Alexandria, Egypt*, [2]*Department of Animal Production*, *Faculty of Agriculture, Ain Shams University, Cairo, Egypt*, [3]*Animal Production Research Institute*, *Ministry of Agriculture, Dokki, Gizza, Egypt*.

Six crossbred sheep (32 kg BW) and six Baladi goats (18 kg BW) were used to evaluate the effect of ZADO (new probiotic, patent No. 22155) as feed direct microbials on feed intake, apparent digestibility and animal growth performance. Sheep and goats were randomly divided into two groups of three animals and fed wheat straw *ad lib*. as a basal diet and commercial concentrate with or without 10g/animal/d of ZADO. A growth performance trial of 65-days was ended by a digestibility trial of 21-days for each individual animal within each group. Feed intake was not affected (P>0.05) by ZADO addition neither in sheep nor goats but it improved the nutrients digestibility coefficients as well as total digestible nutrient of feed in sheep and goats. ZADO significantly increased (P<0.001) the neutral detergent fiber digestibility of diet. The improvement (P<0.001) was more in goats than sheep. Average daily gain and feed efficiency were improved (P<0.05) by addition of ZADO, and the improvement was more in goats than sheep. Calculated net energy required for one kg gain was decreased (P<0.05) by inclusion of ZADO in diets and the decease was more in goats than sheep. Improving the animal performance by addition of ZADO was as a consequence to the improvement in digestibility in sheep and goats. In conclusion, ZADO had improved the nutritive value of wheat straw, as a basal diet in sheep and goats and suggested that its useful roles in activating the ruminal fiber degrading enzymes.

Key Words: Feed Intake, Growth Performance, Sheep

M328 Performance of Holstein cows fed diets containing either alfalfa hay or Tifton 85 bermudagrass with or without a cellulase enzyme. J. K. Bernard*[1], J. W. West[1], and A. T. Adesogan[2], [1]*The University of Georgia*, *Tifton*, [2]*The University of Florida*, *Grainesville*.

Forty-four lactating Holstein cows were used in an 8-wk completely randomized trial with a 2 × 2 factorial arrangement of treatments to determine the effect of forage source and supplemental cellulase enzyme on performance. Diets were based on two forage combinations (corn silage plus 12.5 % DM from either alfalfa hay (**AH**) or Tifton 85 bermudagrass haylage (**T85**)) with (+) or without (-) a commercial cellulase enzyme (Promote N.E.T.-L, Agribrands Purina Canada, Inc., Woodstock, Ontario, Canada). Diets were formulated to provide similar concentrations of protein (16.5% of DM), energy (1.63 Mcal NE_L /kg of DM) and NDF (41.7 % of DM) and were fed once daily as a TMR behind Calan doors for ad libitum intake. The cellulase enzyme was applied at the rate of 4 gram hd^{-1} d^{-1} to the TMR and allowed to mix for 5 min before feeding. The cellulase enzyme provided 1,200 cellulase units of activity per gram. Before beginning the trial, all cows were trained to eat behind Calan doors and then fed the alfalfa hay based diet for 2 wk. Data collected during wk 2 were used as a covariant in the statistical analysis. At the beginning of the 6 wk experimental period, cows were assigned randomly to one of the four experimental diets. No interactions were observed among forage and enzyme for any measures. Daily DMI, milk yield, concentrations milk fat, true protein, lactose, and SNF, 3.5% FCM yield, and dairy efficiency were similar among treatments: 24.3, 41.3, 3.76, 2.81, 4.69, 8.41, 43.0 and 1.78; 24.2, 40.4, 3.70, 2.81, 4.66, 8.37, 41.8 and 1.73; 24.9, 42.1, 3.63, 2.75, 4.65, 8.32, 43.0 and 1.73; 24.6 kg/d, 41.6 kg/d, 3.68% , 2.81%, 4.68%, 8.41%, 42.8 kg/d and 1.74 for AH-, AH+, T85-, and T85+, respectively. These results indicate that Tifton 85 bermudagrass can replace alfalfa hay in rations fed to high producing lactating dairy cows when rations are balanced for NDF. Although cellulase enzymes have been shown to improve ration digestibility and animal performance, there were no advantages observed in the current trial.

Key Words: Tift 85 Bermudagrass, Alfalfa Hay, Milk Yield

M329 Effects of enzyme formulations on roasted grains and rations that contain them. K. F. Wilson*[1], G. V. Pollard[2], and C. R. Richardson[3], [1]*Animal Feed Technologies*, *Greeley, CO*, [2]*Texas State University*, *San Marcos*, [3]*Texas Tech University*, *Lubbock*.

The efficacy of enzymes for improving the nutritional valve over a broad spectrum of feedstuffs is evident and established. However, due to different feeding practices and processing methods, the affects of enzyme formulations are vague and constantly needing evaluation. Thus, an IVDMD study was conducted to determine and establish what effects Cattle-Ase™ C (corn specific) or Cattle-Ase™ S (sorghum specific) enzyme formulations could have on roasted grains and rations that contain them. Samples for corn and sorghum were collected at two different locations, however both feeding operations fed similar ration formulations with the exception of the grain source. The feedstuffs evaluated included roasted corn or roasted sorghum and subsequent rations formulated for starter and finishing cattle. Dry-matter disappearance was evaluated utilizing the Moore modification of the Tilley-Terry procedure at fermentation times of 24 h and 48 h. Results showed that at 24 h, Cattle-Ase treated samples had enhanced digestion. Yet, only the roasted corn, finished corn ration, and the roasted sorghum samples were improved (P = 0.0004, 0.020, and 0.018). At 48 h, the Cattle-Ase treatment still enhanced digestion, but only the roasted sorghum rations were improved (P = 0.007 and 0.005). On average, regardless of substrate and enzyme formulation, the Cattle-Ase treatments enhanced digestion by 17.8% at 24 h and 17.6% at 48 h. Moreover, the results appeared to show that Cattle-Ase C treated substrates responded best at 24 h vs. 48 h, and Cattle-Ase S treated substrates responded best at 48 h vs. 24 h. These responses most likely are attributed to the starch solubility of corn vs. sorghum.

Therefore, it is likely that Cattle-Ase has more of an affect on the rate vs. extent of digestion. As seen in other invitro studies, high-energy feedstuffs show their greatest response within the first 24 h, but tend to level off and show minimal returns to Cattle-Ase′s inclusion at longer periods.

Key Words: Enzyme, Roasted Grain, In Vitro

M330 Effects of monensin, virginiamycin and sodium bicarbonate on rumen fermentation of beef cattle fed medium concentrate. H. Y. Wei, J. Q. Wang*, C. H. Li, D. P. Bu, and L. Y. Zhou, *State Key Laboratory of Animal Nutrition,Institute of Animal Science,Chinese Academy of Agricultural Sciences*, *Beijing, China*.

To assess potential of preventing chronic acidosis in beef cattle fed medium concentrate, effects of monensin, virginiamycin and sodium bicarbonate on ruminal fermentation and fecal pH were studied in a 4×4 Latin-square trial over 64d with four ruminal cannulated steers. The basal diet (8.9 kg DM/hd/d) was fed for control(C), monensin (M; 180 mg/d), virginiamycin (V; 180 mg/d) or sodium bicarbonate (N; 120 mg/d) treatments. The basal diet included 40% Chinese wildrye hay and 60% concentrate. Ruminal pH at 0, 2, 4, 6, 9 and 12h after morning feeding was not different and when averaged was 6.44, 6.51, 6.49 and 6.50 for C, M, V and N, respectively. Also, ruminal total VFA at 0, 2, 4, 6, 9 and 12h after morning feeding were not different and averaged 88.29, 88.18, 95.38 and 92.79 mMol for C, M, V and N, respectively. Average acetate for C, M, V and N was 58.89, 55.63, 62.83 and 61.69 mMol, respectively and that of M was significantly less (p=0.03) than that of V. Average propionate for M (22.41mmol/L) was significantly higher (p=0.0002) than C, V and N (17.45, 17.87 and 18.45 mMol, respectively). Average L-lactic acid for C, M, V and N was 5.12, 4.63, 4.19 and 4.46 mMol (p=0.012) respectively. The potential for L-lactic acid accumulation in vitro was different (p=0.001) for C, M, V and N (6.56,5.98,5.33 and 6.35 mMol). Fecal pH for C, M, V and N was 6.39, 6.85, 6.84 and 6.58 (p=0.0001) respectively. For beef cattle fed medium concentrate, these results indicated that 1) supplementation of monensin and virginiamycin can inhibit lactic acid accumulation in rumen liquid, while virginiamycin tended to be more potent and sodium bicarbonate had little effect; 2) monensin and virginiamycin play a role not only in the rumen but in hind gut, whereas sodium bicarbonate mainly works in the rumen.

Key Words: Ionophores, Sodium Bicarbonate, Beef Cattle

M331 Effects of monensin and *Yucca schidigera* extract on metabolism by ruminal microbes in dual flow continuous culture fermenters. M. Ruiz Moreno* and M. D. Stern, *University of Minnesota*, *St. Paul*.

The effects of Monensin (M) and *Yucca schidigera* extract (YSE) on rumen fermentation were evaluated using a dual flow continuous culture system. Eight fermenters were inoculated with ruminal fluid from a dairy cow in early lactation on day 1 of two 10-d experimental periods. A 58:42 concentrate:forage diet (DM basis) was formulated with 0 (YS0) or 80 ppm (YS80) of YSE as substrate for fermentation. Two concentrations of Monensin, 0 (M0) and 5 ppm (M5), were continuously infused into the fermentation vessels via the artificial saliva. The YS0, YS80, M0 and M5 treatments were randomly assigned in a 2 × 2 factorial arrangement of treatments with two replicates per period. Apparent and true OMD were not affected ($P > 0.05$) by M (42.2 vs 39.6% and 56.1 vs 53.2% for M0 vs M5, respectively) or by YSE (39 vs 42.8% and 52.8 vs 56.6% for YS0 vs YS80, respectively). Maximum pH attained in fermenters was lower ($P < 0.05$) for YS80 than for YS0 (6.14 vs 6.32). Total VFA (140.9 vs 102.7 mM) and propionate concentrations (21.2 vs 36.9 mol/100 mol) were greater ($P < 0.05$) while acetate (63.4 vs 53.9 mol/100 mol), butyrate (10.3 vs 5.3 mol/100 mol), isovalerate (0.28 vs 0.13 mol/100 mol) and 2-methylbutyrate (1.19 vs 0.34 mol/100 mol) were lower ($P < 0.05$) for M5 vs M0 treatment. Total branched chain VFA were greater ($P < 0.05$) with M5 than M0 (1.8 vs 0.7 mol/100 mol), while the A:P ratio was greater ($P < 0.05$) with the M0 treatment (3.11 vs 1.48). Supplementation with YS80 increased ($P < 0.05$) isovalerate (0.29 vs 0.13 mol/100 mol), isobutyrate (0.36 vs 0.20 mol/100 mol) and decreased ($P < 0.01$) 2-methylbutyrate (0.16 vs 0.37 mol/100 mol) compared with YS0. Ammonia N concentration, bacterial N flow, efficiency of microbial protein synthesis and CP degradation were not affected ($P > 0.05$) by the addition of M or YSE. Monensin had substantial effects on total VFA concentration and VFA proportions, while YSE supplementation at 80 ppm only affected branched chain VFA concentrations and maximum pH.

Key Words: Rumen, Monensin, *Yucca Schidigera*

M332 Effects of Yea-Sacc1026 supplementation on rumen pH of loose-housed dairy cattle. A. Bach*[1] and S. Andrieu[2], [1]*Institut de Recerca i Tecnologia Agroalimentàries (IRTA)*, *Barcelona, Spain*, [2]*Alltech Biotechnology Centre*, *Dunboyne, Ireland*.

The aim of this study was to determine the effects on rumen pH of live yeast supplementation in loose-housed dairy cows. Four multiparous lactating rumen-cannulated cows were supplemented (YS) or not (C) with live yeast for 2 periods of 6 wk each, following a cross-over design. The live yeast was top-dressed on the TMR with a single dose of 10 g/d (equivalent to 5x10E10 CFU/d) of Saccharomyces cerevisiae strain 1026 (CBS 493.94, Alltech). The 4 cows were in a group of 50 cows in total, with access to 28 feeding places. During the last 8 d of each period, rumen pH was monitored every 15 min. pH was recorded with an automatic pH meter, placed inside a custom-made PVC pipe with 300 g of lead to ensure that the device remained in the ventral part of the rumen throughout experiment. The rumen was only accessed once every 2 days during samplings. The data were analyzed using a mixed model with repeated measures accounting for the random effect of each cow, and fixed effects of yeast, day of sampling, time since last TMR eating bout, time since previous concentrate consumption, and interaction of yeast with the remaining fixed effects. Yea-Sacc (YS) supplementation did not affect any of the studied feeding behaviors nor DMI. Rumen pH was numerically (P = 0.32) greater for YS than for Control (6.65 vs 6.48. respectively). The coefficient of variation (CV) was numerically lower for YS than for Control (4.91 vs 6.27%, respectively). The average minimum pH for YS (6.53) was numerically greater than the average minimum pH of Control (5.40). Conversely, and in line with the greater variation in rumen pH, the maximum average rumen pH of YS cows was 7.53, whereas the average maximum rumen pH for the C cows was 7.68. YS cows had only 11.1% of their rumen pH below the threshold of 6.2, whereas 26.2% of the rumen pH values were below 6.2 in the C cows. The area under the pH 6.2 for the Control was 0.76±0.09 pH x h/d, whereas the area under the pH 6.2 for YS was 0.67±0.09 pH x h/d (P < 0.05). The results indicate

that live yeasts may have a beneficial effect on rumen pH with cows kept in loose-house conditions receiving rations similar to the one of this study

Key Words: Ruminant, pH, Live Yeast

M333 Rumen fermentation patterns of dairy heifers fed restricted amounts of high, medium, and low concentrate diets and the addition of *Saccharomyces cerevisiae*. G. J. Lascano* and A. J. Heinrichs, *The Pennsylvania State University*, *University Park*.

The objective of this experiment was to investigate ruminal fermentation and *in situ* digestibility of 3 levels of forage:concentrate in diets fed at restricted levels. Three cannulated post-pubertal Holstein heifers (age 18 ± 1 mo; BW 450 ± 20 kg) were fed corn silage (CS)-based diets in a 3-period (35 d) Latin Square Design. Heifers were fed diets for 21 d with no yeast addition, followed by 14 d where yeast culture (YC) was added (1 g/kg as fed basis). A high concentrate (HC) TMR (40% CS, 60% grain; 12.6% CP, 25% NDF), a medium concentrate (MC) TMR (60% CS, 40% grain; 12.3% CP. 28% NDF), and a low concentrate (LC) TMR (80% CS, 20% grain; 12.4% CP, 35% NDF) were fed once/d on a restricted basis to provide 0.22 Mcal ME intake/kg $EBW^{0.75}$. Actual N intake was 165.99 HC, 181.69 MC, 175.21 LC ± 4.3 g ($P > 0.05$). Rumen fluid was sampled on d 18 and d 32 of each period; rumen contents were removed on d 21 and d 35. In situ digestibility was determined on d 15 to 17 and on d 30 to 32. MC diets were incubated with each diet as a control. HC rations had increased in situ rate of DM disappearance (DMD) compared to LC (4.8 vs. 3.4 ± 0.4%/h; $P < 0.06$), but no differences when compared to MC (4.8 vs. 4.0 ± 0.4%/h; $P > 0.1$). No differences were observed in MC in situ digestibility. Mean rumen pH was not different between treatments (6.32, 6.30, 6.30 ± 0.07; $P > 0.1$) and no YC effect was detected. Mean rumen NH3-N concentration was not different among treatments (4.5, 4.7, 4.5 ± 0.7 mg/dL; $P > 0.1$), but YC addition decreased NH3-N in all treatments ($P < 0.01$). Total wet and dry rumen contents, and DM turnover were different between all treatments ($P < 0.01$). From these results we conclude that feeding HC diets in restricted amounts increases DMD rate while having minimal effects on rumen fermentation patterns between different forage:concentrate diets. YC modified NH3-N utilization in the rumen in all 3 diets in this study.

Key Words: Forage:Concentrate, Rumen Fermentation, Yeast Culture

M334 Addition of three yeast cultures to diets for dairy cows in mid-lactation. K. E. Cowles*[1], M. R. Murphy[1], and J. W. Jones[2], [1]*University of Illinois*, *Urbana*, [2]*Western Yeast Co.*, *Chillicothe, IL*.

Our objective was to compare the effects of three concentrated yeast cultures fed with a totally mixed ration to dairy cows in mid-lactation. Eight multiparous Holstein cows (averaging 155 DIM at the start of the trial) were assigned to one of two 4 × 4 Latin squares, blocked by average daily milk yield for the previous week. Cows received a basal diet composed of corn silage, alfalfa silage, chopped alfalfa hay, ground corn, soybean meal, whole cottonseed, wet brewers grain, vitamin-mineral mix, and monensin. The four treatments included: control (14 g of cornmeal), 14 g of Western Yeast Cel-Con, 14 g of Western Yeast Cel-Con-5, or 14 g of Diamond V-XPC yeast. Dosages were according to tag instructions and treatments were topdressed daily at 1000 h. Experimental periods were 21-d long. Cows were milked twice daily at approximately 0600 and 1600 h. Milk composition was analyzed once weekly. Cows were administered Cr_2O_3 twice daily for the last 10 d of each period. Fecal grab-samples were collected twice daily for the last 5 d of each period, composited, and subsampled for Cr_2O_3 analysis. Data were analyzed using the MIXED procedure of SAS. One cow was removed after period 1 because of teat injury. Dry matter intake, 3.5% FCM yield, milk fat percentage and yield, milk protein percentage and yield, FCM:DMI, and apparent total-tract digestibility of DM were unaffected by treatment. Yeast cultures did not affect measured variables; however, stage of lactation and increased variation because of heat stress likely reduced experiment sensitivity.

Table 1.

	Treatment					
	Control	Cel-Con	Cel-Con5	DV-XPC	SE	*P*-value
DMI, kg/d	21.9	20.8	20.8	22.1	1.60	0.898
BW, kg	656	627	625	635	23.71	0.761
3.5% FCM, kg/d	31.3	29.5	29.9	31.1	2.20	0.915
Milk fat , %	2.88	2.89	2.86	2.91	0.11	0.992
Milk fat, kg/d	1.01	0.94	0.99	1.01	0.10	0.992
Milk protein, %	2.89	2.88	2.85	2.88	0.17	0.997
Milk protein, kg/d	0.89	0.86	0.88	0.90	0.07	0.975
FCM:DMI	1.37	1.39	1.51	1.45	0.08	0.561
DM digestibility, %	55.3	57.1	54.3	56.5	1.57	0.669

Key Words: Yeast Culture, Dairy Cow, Digestibility

M335 Effects of dietary yeast culture supplementation on milk production and somatic cell counts at a commercial dairy. C. R. Richardson*[1,3], D. W. Boyles[2], D. B. Wester[3], H. P. Hagaman[1,3], J. E. Vander Dussen[1,3], and G. V. Pollard[4], [1]*The Center for Feed Industry Research and Education*, *Lubbock*, [2]*LDJ Nutrition*, *Lubbock, TX*, [3]*Texas Tech University*, *Lubbock*, [4]*Texas State University*, *San Marcos*.

Sixteen pens of lactating Holstein cows were utilized in a 64 d yeast culture supplementation experiment to determine the effects of yeast source on milk production, somatic cell counts, feed intake, and health status. Treatments evaluated were: control, GRO-TEC, yeast, Diamond V yeast, and Western yeast. Upon initiation of the trial, 3,600 cows were utilized. As the daily cow husbandry protocol demanded, cow pen movements reduced the final number of cows used in the statistical evaluation of this experiment to 2,213 hd. Cows that did not remain in the same pen throughout the duration of the experiment were eliminated. Pen was the experimental unit for statistical comparison. Milk test days for variables being studied were: initial on August 7, month one of September 11, and month two on October 9. Means for variables were calculated by treatment for all cows in treatment pens (n=2,213) and also for those cows in mid-lactation (n=1,014). Mid-lactation cows were those over 60 d in milk or less than 230 d in milk. There were no differences among yeast sources across treatments for milk production (P=0.2656 for all cows and P=0.2180 for mid-lactation cows), or for somatic cell counts (P=0.1926 for all cows and P=0.4846 for mid-lactation cows). Milk production ranged from 32.1 kg/d to 34.8 kg/d, while somatic cell counts varied from

83,700 to 186,000.Milk production and somatic cell counts differed by month for all cows (P = 0.0001 and P = 0.008) and for mid-lactation cows P = 0.0001 and P = 0.080), respectfully. This study indicates possible benefits from yeast supplementation in high lactation Holstein cows and may be related to somatic cell counts.

Key Words: Lactation, Milk Production, Yeast Culture

M336 Blood metabolites in Holstein steers fed diets with different concentrate to alfalfa hay ratios. A. R. Vakili, M. Danesh Mesgaran*, A. Heravi Moussavi, and R. Valizadeh, *Ferdowsi University*, *Mashhad, Khorasan, Iran*.

In dry and semiarid regions, because of low pasture availability, ruminant diets are based on concentrates. The objective of the present experiment was to investigate the effect of diets providing different concentrate to alfalfa hay ratios on blood metabolites in Holstein steers. Four Holstein steers with initial body weight of 300±15 kg fitted with ruminal Fistulae were used in a 4×4 Latin square design (28 days of each period). Animals were fed 7 kg of DM of diets differing in concentrate [155 g CP kg-1 of DM; consisted of maize, barley, soybean meal, sugar beet pulp, wheat bran, cottonseed meal, CaCo3, mineral and vitamin premix, salt (30, 34, 8, 5, 10, 12, 0.3, 0.5, and 0.2 g/100g DM; respectively)] to alfalfa hay ratios as 60:40 (C_{60}:L_{40}), 70:30 (C_{70}:L_{30}), 80:20 (C_{80}:L_{20}) and 90:10 (C_{90}:L_{10}). Steers fed the experimental diets as total mixed ration twice daily at 0800 and 2000 h. At day 24 of the each experimental period, blood samples were taken from jugular vein before the morning feeding, 2, 4 and 6 h post feeding. Serum samples were measured for glucose and urea N by Spectrophotometer (CE 1021, England). Data were analyzed using the GLM procedure of SAS and the means compared by the Duncan test (P <0.05). Blood glucose was similar among diets but blood urea N was affected by treatments. The results of this study indicated that the blood glucose values were not significantly influenced by the concentrate to alfalfa hay ratios but urea N values were influenced significantly.

Table 1. Blood glucose and urea N (mg/dl) in Holstein steers fed diets differing in concentrate: alfalfa hay ratios

Item	Time (h)	Concentrate: alfalfa hay ratio[1]				
	Treatment effect					
	60:40	70:30	80:20	90:10	SEM[2]	P
Glucose	0.0	86.95	87.50	85.72	89.91	4.46	0.31
	2.0	84.50	87.82	86.10	93.37		
	4.0	89.42	91.78	95.27	84.74		
	6.0	93.20	93.40	90.60	92.78		
Blood Urea N	0.0	10.36	7.71	8.11	9.41	0.5	0.04
	2.0	11.42	9.72	11.46	9.90		
	4.0	11.10	9.50	10.82	8.80		
	6.0	10.62	10.22	10.03	9.13		

1: Values were reported as the mean of four sampling periods. 2: SEM= Standard Error of Mean

Key Words: Fistulae, Blood Metabolites, Alfalfa Hay

M337 Effects of corn and alfalfa particle size on ruminal fermentation, digestibility and chewing activity of dairy cows in midlactation. Z. J. Cao*, S. L. Li, M. Ma, and L. L. Wang, *China Agricultural University*, *Beijing, China*.

This study evaluated the effects of, and interactions between, corn particle size and alfalfa particle size on dry matter intake (DMI), milk production, milk composition, ruminal fermentation, microbial yield, chewing activity and nutrient digestibility in midlactating dairy cows. Four multiparous Holstein cows with ruminal cannulas, averaging 595 kg (SD =52) of body weight and 121 DIM (SD= 21) at the start of the experiment, were assigned randomly to a 4 × 4 Latin square design. Experimental periods were 21 d in length (14 d of treatment adaptation and 7 d of data collection). All diets were fed as TMR and were formulated to meet or exceed the requirements of a 600 kg multiparous cow producing 20 kg milk/ d with 4.0% fat. The ratio of concentrate to forage was 40:60 (DM basis). Treatments were arranged in a 2 × 2 factorial design; two levels of alfalfa particle size (2.54 cm and 6.22 cm) were combined with concentrates based on either ground corn (711 µm) or cracked corn (1755 µm). Corn and alfalfa particle size did not affect DMI, milk production and milk fat percentage. Milk protein percentage increased when corn particle size was decreased (P=0.04). Milk urea nitrogen was lower for cows fed ground corn compared to cracked corn (118 vs 134 mg/ l, P=0.05). Estimated microbial N supply increased 41.9 g/d for ground corn compared to cracked corn. Cows fed long alfalfa hay spent more time ruminating compared with cows fed short alfalfa hay ranging from 293 to 336 min/d (P<0.001). Total time spent on chewing by cows increased from 505 to 574 min/d (P=0.002) for short alfalfa and long alfalfa, respectively. Based on the results from this study, dairy cows can be fed diets that contain ground corn and short alfalfa hay without leading to negative effects on rumen pH or nutrient digestibility.

Key Words: Corn Particle Size, Alfalfa Particle Size, Ruminal Fermentation

M338 Effect of feeding pistachio by-product on milk yield, apparent nutrient digestibility and chewing activity of early lactation Holstein cows. A. Bohluli, A. A. Naserian*, R. Valizadeh, and F. Eftekharshahroodi, *Ferdowsi University*, *Mashhad, Iran*.

Eight multiparous Holstein cows in early lactation (57 ± DIM) were assigned into a replicated 4 × 4 Latin square design with 3-wk periods to study the effect of Pistachio By-product (PB) on their performance. Control diet consisted of 60% concentrate, 20% alfalfa, 5% cottonseed, and 15% corn silage. Pistachio by-product was substituted with corn silage at 0, 5, 10, and 15% in DM of control diet according to treat 1 to 4. DMI, daily milk yield and composition were not affected by treatments, although fat daily yield, Economically Corrected Milk (ECM) and 4% FCM were decreased linearly (P<0.1) and daily milk protein yield was increased quadratically (P<0.15) by increasing PB level in the diet. Milk urea nitrogen and Blood concentration of glucose, urea, and Hb were not affected by treatments. Urine pH was increased from 7.7 to 8.0 linearly (P<0.01) from T1 to T4. Crud protein digestibility was similar for all diets (P<0.15), but by increasing PB level in the diet, digestibility of DM, OM, NDF and ADF were decreased linearly (P<0.05). Daily rumination and chewing activity alone or per DM, NDF or ADF daily intake were linearly decreased when PB level increased in the diet (P<0.05). It seems the reduction in milk fat might be due to decrease in structural carbohydrate digestion and chewing activity by increasing PB in the lactating cow diet. The

results show the pistachio by-product can be used as a part of forage in the lactating cow diet; however it cannot be a perfect substituting for roughages in the diet.

Table 1.

Item	T1	T2	T3	T4	SEM
DMI, kg/d	30.4	30.6	31.5	30.6	0.29
Milk, kg/d	47.0	46.2	46.4	45.7	0.26
ECM, kg/d	46.0	45.8	46.4	43.0	0.3
FCM, kg/d	40.2	40.0	39.3	37.8	0.29
Fat, kg/d	1.43	1.44	1.38	1.30	0.07
Pro., kg/d	1.47	1.46	1.51	1.40	0.05
MUN, mg/dl	17.8	17.3	16.9	16.8	0.35
DDM, %	70.3	68.8	68.4	67.7	0.27
DOM, %	71.7	70.1	69.4	68.4	0.26
DCP, %	71.2	70.2	70.9	69.6	0.3
DNDF, %	55.3	53.2	50.9	51.0	0.35
DADF, %	54.1	49.6	48.6	47.0	0.43
Chew., h/d	14.5	13.1	12.8	10.5	0.25
Che/NDFI, min/kg/d	95.1	88.2	87.5	74.7	0.67

Key Words: Pistachio By-Product, Milk Yield, Apparent Digestibility

M339 Probiotics in growing pre-ruminant calves. J. B. Cannon*[1], D. L. Harmon[1], K. R. McLeod[1], and A. J. Gallegos[2], [1]*University of Kentucky*, *Lexington*, [2]*synBios*, *SA de CV Queretaro, Mexico*.

This study evaluated the addition of a Bacillus-based probiotic to milk replacer and starter for preruminant calves. Thirty-four dairy calves (1 to 4 d old) were housed individually and blocked by sex and birthdate with treatments assigned randomly within blocks. The treatments were probiotic (Bacillus subtilis + Bacillus licheniformis; 10^9 cfu/day) added to the milk replacer and starter or control (no additive). During the study, probiotic treated calves received a commercial starter containing 10^6 cfu/g starter while control calves were offered starter with no additive. All calves received a milk-based milk replacer containing their treatment during the initial 14 days on the experiment. On d 15, they were abruptly switched to a soy-based milk replacer. All calves remained on the soy-based milk replacer and their respective treatment until weaning. Weaning occurred when starter consumption exceeded 1% of body weight for three consecutive days. After 42 days on the study, unweaned calves were reduced to one feeding of milk replacer daily to promote increased starter intake. Weaned calves were maintained on their respective treatments through the total of 56 days on experiment. Dry matter intake (sum of the two food sources) was recorded daily and fecal output was scored (fecal scoring: fluidity, 1=normal, 2=soft, 3=runny, 4=watery; Consistency, 1=normal, 2=foamy, 3=mucus, 4=sticky, 5=constipated; Odor, 1=normal, 2=slightly offensive, 3=highly offensive). A scour day was recorded if fluidity=3 or 4, consistency=3, and odor=2 or 3. Calves were weighed weekly and measured for hip and wither height, hip width and heart girth. Blood samples were collected weekly for determination of hematocrit. Treatment did not affect days to weaning, however calves receiving the probiotic treatment had numerically greater ADG and BW gain (24.6 vs. 22.0 kg). There were no differences between treatments in feed efficiency, scour days per calf, hematocrit, hip and wither height or heart girth. Probiotic treated calves tended (P=0.07) to gain more in hip width. These results indicate that calves housed indoors in a temperature controlled environment with little added stressor may not benefit from probiotic feeding.

Key Words: Probiotic, Calf, Stress

M340 The performance of calves fed starter feeds containing distillers grains. A. B. Chestnut* and D. L. Carr, *Vigortone Ag Products*, *Hiawatha, IA*.

The value of dried distillers grains with solubles (DDGS) as an ingredient in calf starter feed was evaluated in two trials using Holstein bull calves that averaged 5 days of age (+/- 3 d) with a mean BW of 43.9 kg (Trial 1) or 41.6 kg (Trial 2). For each trial 106 calves were randomly assigned to treatments and weighed on d 1, 35, and 56 (Trial 1) or 60 (Trial 2). Each calf received 284 g commercial milk replacer twice daily from d 1 to 28 and once daily from d 29 to 35. Starter feeds were offered ad libitum beginning d 1. All starters were fortified with the same vitamin/mineral premix and formulated to contain 18% CP. The texturized control starter (CON) in both trials was composed of steam-flaked corn, oats, roasted soybeans, molasses, and a pellet containing soybean meal (SBM), fish meal, blood meal, corn gluten meal, and premix. Trial 1 compared CON with 3 pelleted starters composed of ground-corn, SBM, molasses, premix and DDGS. Treatments containing DDGS were: DG10 (10% DDGS), DG10L (10% DDGS + 0.1% L-lysine HCl), and DG20L (20% DDGS + 0.1% L-lysine HCl). From d 1 to 35 ADG was 475 g and did not differ among treatments (P>0.20). From d 35 to 56 ADG was 825, 765, 726, and 689 g for calves on treatments CON, DG20L, DG10L, and DG10, respectively. The CON supported more weight gain (P<0.05) than either DG10L or DG10. DG20L was not different (P>0.05) from either the CON or the DG10L and DG10 treatments. Trial 2 compared CON to a whole-corn/SBM/DDGS starter with 20% DDGS (DG) and a whole-corn/SBM starter (SB). All starters were formulated to 18% CP. The ADG from d 1 to 35 was 438, 427, and 343 g and from d 1 to 60 was 600, 565 and 501 g for CON, DG and SB treatments, respectively. The CON and DG treatments supported similar ADG. The SB treatment supported less (P<0.05) ADG than CON and DG treatments at d 35 and less (P<0.05) ADG than CON at d 60. In these trials starters with 20% DDGS supported ADG similar to a traditional texturized calf starter.

Key Words: Distillers Grains, Starter Feed, Calves

M341 Effect of feeding yeast culture on performance, health, and immunocompetence of dairy Calves. V. J. A. Magalhaes*[1], F. Susca[1], A. F. Branco[2], I. Yoon[3], and J. E. P. Santos[1], [1]*Veterinary Medicine Teaching and Research Center, University of California Davis*, *Tulare*, [2]*Univesidade Estadual de Maringa*, *Maringa, Brazil*, [3]*Diamond V Mills, Inc.*, *Cedar Rapids, IA*.

Objectives were to determine the effects feeding yeast culture (Diamond V XP, Diamond V Mills, Inc.) on performance, health and immunocompetence of calves from 2 to 70 d of age. Holstein calves (n = 512; 2±1 d of age) were randomly assigned to receive 0 (CON; 223 females and 34 males) or yeast culture at 2% of grain DM (YC, 218 females and 37 males). Calves were housed in individual hutches and received 3 feedings of 1.9 L of colostrum in the first 24 h, and pasteurized milk thereafter to 60 d of age. Grain intake was measured 5 d each week for each calf, while BW was measured on d 5, 30 and

68. Attitude and fecal consistency were scored daily. Incidence and duration of health disorders and treatments were recorded. Neutrophil phagocytic and killing activities and antibody response to immunization with ovalbumin were evaluated. Data were analyzed using the LOGISTIC, MIXED, and LIFETEST procedures of SAS. Grain intake did not differ (P = 0.54) between treatments and averaged 908 g/d. Body weight change was similar (P > 0.10) for YC and CON between d 5 and 30 (212 and 229 g/d) and d 30 and 68 (772 and 780 g/d). Glucose (76.1 vs. 71.9 mg/dL) and 3-hydroxybutyrate (0.343 vs. 0.344 mM) concentrations did not differ (P = 0.92) between YC and CON. Attitude scores were similar between treatments throughout the study, but calves fed YC had improved (P = 0.06) mean (1.44 vs. 1.47) and median (1.2 vs 1.3) fecal scores and fewer (P < 0.01) days with diarrhea (4.6 vs. 5.9%). Incidence of fever tended to be reduced (P = 0.08, 34.1 vs. 41.6%) and the risk of health disorders (cases/1000 calf days at risk) was reduced (P = 0.03, 40 vs. 49) with YC in the diet. Minor effects on neutrophil function were observed, and YC tended to improve (P < 0.10) killing of phagocytized bacteria. Yeast culture improved (P = 0.06) survival of calves (92.5 vs. 87.9%) because of a decline (P = 0.05) in mortality rate after 15 d of age. Incorporation of YC in the grain did not alter intake and weight gain, but improved health and survival of dairy calves.

Key Words: Calves, Yeast Culture, Health

M342 The effect of feeding different milk replacer programs on calf growth, health and serum glucose. T. J. Earleywine*[1], T. E. Johnson[1], B. J. Nonnecke[2], and B. L. Miller[1], [1]*Land O'Lakes, Inc.*, *Webster City, IA*, [2]*USDA, ARS, National Disease Center*, *Ames, IA*.

Twenty-six (26) Holstein bull calves (mean=45.6 kg) were employed in a 63 day trial to evaluate milk replacer (MR) feeding programs. Calves were allotted to treatment based upon weight and blood gamma globulin status. Calves were fed a conventional product (20% protein / 20% fat) to provide 227 g or an intensified product (28% protein / 20% fat) to provide 568 g of MR powder twice daily. Milk replacers contained all-milk protein and were medicated with neomycin and terramycin. The conventional and intensified products were fed through days 35 and 49, respectively. Calf starter (18% CP for conventional or 22% for intensified) was fed throughout this 63 day trial. Total gain, MR intake and F/G were improved (P<.05) for calves fed intensive product when compared with calves fed conventional product. Calves fed the conventional product had lower serum glucose levels than those fed the intensified product during the milk replacer feeding phase. After weaning, serum glucose levels of conventional product calves increased to that of intensified product fed calves.

Table 1. Serum Glucose, mg / dL

Diet	Day 14	Day 28	Day 35	Day 49	Day 61
Intensified	119.6	95.7	106.0	85.2	115.7
Conventional	71.7	60.1	72.0	73.2	120.8
P-value	.0003	.0041	.0011	.076	>.10

Key Words: Calf, Milk Replacer, Glucose

M343 First lactation milk yield and fertility of Holstein heifers reared using three milk replacer feeding regimes. P. C. Aikman*[1], M. Gould[2], and E. C. L. Bleach[3], [1]*University of Reading*, *UK*, [2]*Volac International Ltd*, *Royston, UK*, [3]*Writtle College*, *Chelmsford, UK*.

Holstein heifer calves previously used to study effect of pre-weaning feeding regime on calf growth rates were monitored until their second calving to assess effects on milk yield and reproductive performance. Calves were blocked according to birthweight and parity of dam then assigned 48 h after birth to warm ad libitum milk replacer (WA; n = 25), cold ad libitum milk replacer (CA; n = 25) or 4 l/d of warm milk replacer offered in 2 equal feeds (WR; n = 25). The same milk replacer (crude protein 260 g/kg, oil 160 g/kg, ash 70 g/kg; 100 g/l water) was used for each treatment. Ad libitum water, calf concentrate and barley straw were available pre-weaning. All animals were managed identically from weaning at six weeks of age until their second calving. WR animals tended to have lower daily liveweight gains from birth until 12 months of age and lower first parity pre-calving bodyweight. Age at first AI (420 ±7 d) and the number of services per conception as maiden heifers were similar. Age at first (720 ±13 d) and second (1108 ±28 d) calving, total first lactation milk yield (9146 ± 565 kg) and daily milk yield were not affected by treatment. Animals on the WA treatment tended to require less intervention for reproductive problems during the first lactation, hence calving interval and lactation length were numerically shorter. In conclusion, animals allocated to the WA treatment tended to have improved pre-breeding growth rate and reproductive performance in the first lactation, though the limited numbers of animals in the treatment groups prevented significant differences being detected.

Table 1.

	WR	CA	WA	SED	P
Liveweight gain, birth-12 months, kg/d[1]	0.909	0.943	0.958	0.020	0.067
First parity pre-calving bodyweight, kg[1]	634	652	659	14.1	0.200
Services/conception (maiden heifers)[1]	1.70	1.71	1.59	0.277	0.903
Milk yield, kg/d[1]	26.6	27.6	28.6	1.23	0.291
Lactation length, d[1]	344	342	310	15.4	0.069
Proportion of animals requiring reproductive intervention[2]	0.57	0.48	0.22	-	0.080
Calving interval, d[1]	405	394	376	27.6	0.606

[1]ANOVA [2]Chi-square

Key Words: Heifers, Rearing Period, Fertility

M344 Effects of early intensified nutrition on growth and metabolism of neonatal dairy calves. C. C. Williams*[1], D. T. Gantt[1], C. F. Hutchison[1], C. C. Stanley[1], and M. A. Froetschel[2], [1]*Louisiana State University Agricultural Center*, *Baton Rouge*, [2]*University of Georgia*, *Athens*.

A study was conducted to determine if early intensified nutrition would improve performance of neonatal dairy calves in southeast Louisiana. Thirty-one calves (19 male; 12 female) were assigned to one of two dietary treatments. Treatments included an accelerated feeding program or the conventional feeding program in use at the LSU Dairy Farm. The accelerated feeding treatment (ACC) consisted of milk replacer (Cow's Match, Land O'Lakes, 28% CP, 20% fat) and

22% CP calf starter, and the conventional treatment (CON) consisted of milk replacer (20% CP, 20% fat, Land O′Lakes) and 18% CP calf starter. Both treatments were fed according to recommended procedures. On day 42 milk replacer was reduced by 50%, and on day 49 all calves were weaned. Body weights were measured at birth and weekly through weaning. Additionally, hip height, wither height, and body length were measured weekly. Feed intake and fecal scores were recorded daily. Beginning on day 7 and continuing weekly through weaning, blood samples were collected prior to morning feeding for analysis of IGF-I. On day 25 and again on days 56, 84, 112 rumen fluid was collected for analysis of pH and short chain VFA to evaluate possible differences in rumen development. Calves on the ACC treatment had greater ($P < 0.01$) body weight gain and fecal scores and decreased starter intake when compared to CON calves. There was a treatment by week interaction ($P < 0.01$) for ADG, with calves on ACC having higher ADG through week 5 and CON calves having higher ADG from weeks 6 through 8. Wither height, hip height, and body length were greater ($P < 0.05$) in ACC calves. There were no effects ($P > 0.05$) of treatment on pH, IGF-I or VFA concentrations. However, there were treatment by week interactions ($P < 0.05$) for rumen concentrations of acetate, propionate, and total VFA. There was an effect of week ($P < 0.01$) on IGF-I concentrations and on rumen pH. These data indicate that early intensified nutrition does improve growth in young dairy calves. However, rumen development may be affected due to decreased starter intake and the effects on rumen VFA concentrations.

Key Words: Calves, Early Intensified Nutrition, Growth

M345 Partial replacement of whole milk with soymilk stimulates early calf starter intake, saves milk, and reduces weaning age and costs. G. R. Ghorbani[1], R. Kowsarzar*[1], M. Alikhani[1], and A. Nikkhah[2], [1]*Isfahan University of Technology*, *Isfahan, Iran*, [2]*University of Manitoba*, *Manitoba, Canada*.

Evidence has been accumulating that cow's milk must not be considered undesirable for human health simply because of its cholesterol and saturated fatty acids. Milk, instead, contains bioactive substances that may reduce the risk of cancer and cardiovascular diseases. Partial replacement of whole milk with soymilk was hypothesized to stimulate starter intake, hasten rumen development, and reduce weaning age, thereby reducing feed costs and saving more milk. The primary objective of the current study was to determine the effects of partial replacement of whole milk with soymilk on pre-weaning calf performance and feed costs. Following 3-d of colostrum and transition milk feeding, twenty seven neonatal Holstein calves (41.6 ± 1.6 kg body weight; mean ± SE) were assigned in a completely randomized design to three treatments: 1) whole milk (M), 2) 75% M + 25% soymilk (S25), or 3) 50% M + 50% soymilk (S50), fed at 10% of body weight, on a wet basis. The weaning criterion was defined as the calf age at a daily intake of 900 g starter concentrate lasting for two weeks. During the first two weeks of the trial, treatments did not differ in starter intake and fecal score; however, the M- and S25-fed calves gained more weight ($P<0.05$) than did S50-fed calves. By 49 days of age, S25-fed but not S50-fed calves gained competitively similar body weight as M-fed calves. The S25- and S50-fed calves achieved a minimum daily starter intake of 900 g respectively about 10 and 12 d earlier than did M-fed peers ($P<0.01$). As a result, soymilk fed calves consumed about 20% less milk than M-fed calves to meet the weaning criterion ($P<0.05$). Because M was about 50% more expensive than both soymilk and starter concentrate, feed-related weaning costs dropped by about 35% when soymilk was fed ($P=0.06$). Saving more milk will have nutritional implications as to the increasing human demands for milk products.

Key Words: Calf, Soymilk, Weaning

M346 Evaluation of Jersey calves fed milk replacers and starter of varying protein and fat composition. E. H. Jaster*, J. L. Beckett, and D. G. Peterson, *California Polytechnic State University*, *San Luis Obispo*.

The objective of this study was to evaluate the growth and performance of Jersey calves fed milk replacer and starter with different amounts of protein and fat. Three day old Jersey calves (n=24) were assigned to one of three diets. From d 3 to 42, calves in treatment 1 were fed a standard MR (20% CP and 20 % fat) and an 18 % CP pelleted starter. Calves in treatment 1 were fed 236 g of milk replacer and fed at constant rate of 1.89 L of warm water per feeding with a nipple bottle. Milk replacer was fed twice daily in two equal feedings at 0600 and 1800 h. Treatment 2 calves were fed a MR (22 % CP and 22 % fat) and 18 % CP starter. Treatment two calves were fed the same amounts of milk replacer and schedule as treatment 1. Treatment 3 calves were fed a MR (30 % CP and 25 % fat) and 25 % CP starter. The CP content of each milk replacer was derived from all-milk sources and the fat content was choice white grease. During wk 7, calves in all treatments were fed half the daily amount offered during wk 2-6 and weaned at the end of wk 7. During the experiment, calves were offered ad libitum intake of a starter from wk one to ten; intake was measured weekly between wk 1 to 3 and daily from wk 4 to 10. Calves weights, fecal consistency scores, heart girth, height at withers and body length were measured weekly. A blood sample was drawn by jugular venipuncture wk 1 (start) and wk 2, 4, 6, 8, and 10. Samples were assayed for glucose and serum urea nitrogen. Increasing levels of dietary protein and fat resulted in greater overall body weight ($P<0.05$), though body weight was not different at week 10 between treatment 2 and 3 ($P>0.50$). Plasma glucose was similar across all groups with no effect of diet ($P>0.50$). Urea nitrogen was not different between treatments 1 and 2, but elevated in animals fed treatment 3.

Key Words: Dairy, Calves, Milk Replacer

M347 Pre- and post weaning performance and health of dairy heifer calves fed milk replacers supplemented with oligosaccharides. B. Ziegler*[1], R. Larson[1], S. Hayes[2], H. Chester-Jones[3], D. Ziegler[3], J. Linn[4], M. Raeth-Knight[4], and G. Golombeski[4], [1]*Hubbard Feeds*, *Mankato, MN*, [2]*Milk Products*, *Chilton, WI*, [3]*University of Minnesota Southern Research and Outreach Center*, *Waseca*, [4]*University of Minnesota*, *St. Paul*.

One-hundred one 2 to 4 day-old dairy heifer calves were randomly assigned to one of 4 non-medicated, all-milk protein (20% protein:20% fat) milk replacers (MR) with supplemental treatments to evaluate their effect on pre- and post weaning calf performance and health. Calves were housed from July to September in 2.29 x 1.17 m individual calf pens, within a frame-steel curtain side-wall, naturally ventilated barn. Initial BW averaged 40.4 kg ± 0.69 kg. Treatments were: 1) MR control; 2) MR with mannan oligosaccharides (Bio-mos®, fed at 2 g/calf daily); 3) MR with fructo-oligosaccharides (inulin, fed at 5.67

g/calf daily) and, 4) MR with a combination of Bio-mos® (2 g/calf daily) and inulin (5.67 g/calf daily). Milk replacers were fed at 0.284 kg (as-fed) in 1.99 L water 2× daily for the first 35 d, and then 1X daily from d 36 to weaning at 42 d. Calves were offered a 20.4% CP (DM basis) texturized calf starter (CS) and had access to fresh water at all times. Total DMI from MR for 42 d averaged 20.58 kg/calf. There were no pre- and post weaning performance differences by treatments (P > 0.05). Pre-weaning CS DMI, total DMI, total gain and feed/gain averaged 17.32, 37.90, 22.81 and 1.67 kg, respectively. Post weaning CS DMI, total gain, and feed/gain averaged 26.51, 12.75 and 2.08 kg, respectively. Overall 56-d daily gain and feed/gain averaged 0.64 and 1.79 kg, respectively. Pre-weaning fecal scores for the control MR calves tended (P = 0.07) to be lower than calves fed the other treatments. Health treatment costs/calf averaged $3.24, $3.17, $3.88 and $3.97 for calves fed treatments 1, 2, 3 and 4, respectively. Under the conditions of this study, feeding a MR supplemented with oligosaccharides did not affect pre- and immediate post weaning calf performance.

Key Words: Dairy Calves, Milk Replacer Supplements, Performance

M348 Pre- and post weaning performance and health of dairy heifer calves fed milk replacers with different protein sources. S. Hayes*[1], B. Ziegler[2], R. Larson[2], H. Chester-Jones[3], D. Ziegler[3], J. Linn[4], M. Raeth-Knight[4], and G. Golombeski[4], [1]*Milk Products*, *Chilton, WI*, [2]*Hubbard Feeds*, *Mankato, MN*, [3]*University of Minnesota Southern Research and Outreach Center*, *Waseca*, [4]*University of Minnesota*, *St. Paul*.

One-hundred twenty-four 2 to 4 d-old dairy heifer calves were randomly assigned to 1 of 5 medicated (20% CP:20% fat) milk replacers (MR) with 4 MR partially replacing milk protein with plant-based sources to measure pre- and post weaning performance and health. Calves were housed in 2.29 x 1.17 m individual calf pens within a frame-steel, curtain side-wall, naturally ventilated, barn. Initial BW averaged 40.9 ± 0.79 kg. Treatments were: 1) MR with all-milk protein (CON); 2) MR with hydrolyzed wheat gluten protein replacing 50% of the milk protein (50WG); 3) MR with soybean protein concentrate replacing 50% of the milk protein (50SPC); 4) MR with WG replacing 30% of the milk protein (30WG); and 5) MR with 25% WG and 25% SPC replacing milk protein (25SPCWG). Milk replacers were fed at 0.284 kg (as-fed) in 1.99 L water 2× daily for the first 35 d, and then 1X daily from d 36 to weaning at 42 d. Calves were offered a 20.2% CP calf starter (CS) and had access to fresh water. Total DMI from MR averaged 21.8 kg/calf. Calves fed CON had 4.09 kg greater (P < 0.05) pre-weaning gain compared to other groups. Overall ADG and feed/gain were 0.78, 1.80; 0.71, 1.85; .70, 1.98; 0.69, 1.88; 0.68 and 1.93 kg for calves fed CON, 50WG, 50SPC, 30WG and 25WGSPC, respectively. Health treatment costs/calf averaged $2.09. Under the conditions of this study, feeding an all-milk protein MR with CS resulted in excellent growth. The use of WG and SPC as a partial replacement for milk protein reduced calf performance due mainly to CS intake differences. Plant-based MR protein sources do have the potential to reduce feed costs to weaning.

Key Words: Dairy Calves, Milk Replacer Protein Sources, Performance

M349 Comparison of three analytical methods to assess urea nitrogen in colostrum. N. E. Lobos*[1], M. A. Wattiaux[1], and G. A. Broderick[1,2], [1]*University of Wisconsin*, *Madison*, [2]*US Dairy Forage Research Center*, *Madison, WI*.

Recent research has suggested that milk urea nitrogen is correlated with feed efficiency (FCM/DMI) and thus the cow's metabolic status in early lactation. Colostral urea nitrogen (UN) may provide useful information for early lactating cow management. Thus, we studied three methods to determine colostral UN. Starting 2 wks before calving, 27 Holstein cows were fed a 13.2% CP diet. Colostrum samples were collected and preserved frozen with bronopol until analysis. After thawing, three sub-samples were obtained. The first one was analyzed in a commercial laboratory by near infrared spectroscopy (NIR) using a Foss 6000 instrument calibrated for milk. The second sub-sample was centrifuged to remove fat and analyzed using a colorimetric urease-based assay with sodium nitroprusside as catalyst (Berthelot reaction (BR)). After deproteinization, the third sub-sample was analyzed by an automated colorimetric assay using the Diacetyl Monoxyme method (DAM) adapted to a flow-injection analyzer (Lachat QuikChem 8000). Data were analyzed using Proc REG of SAS. Linear models assumed no intercept. Average and (standard deviation) of colostral UN were 20.9 (14.8), 9.5 (4.5), and 11.1 (4.3) mg/dL for the NIR, BR, and DAM methods, respectively. Values ranged from 0.6 to 62.5, from 1.2 to 18.0 and from 4.2 to 23.3 mg/dL for the NIR, BR, and DAM methods, respectively. Regressions were as follow: NIR-UN = 1.69 (standard error (se) = 0.34) x BR-UN (r^2 = 0.49, root MSE = 18.6); NIR-UN = 1.66 (se = 0.27) x DAM-UN (r^2 = 0.60, root MSE = 16.5), and BR-UN = 0.84 (se = 0.06) x DAM-UN (r^2 = 0.89, root MSE = 3.5). For each regression, the slope differed from 1.0 (P<0.05). Because true colostral UN was not known, the most accurate technique could not be established, but the NIR-UN was the least precise. The NIR-UN was poorly correlated with BR-UN and DAM-UN, but the latter two methods were in close agreement. The wide variation in colostral UN most likely reflected metabolic differences among cows at parturition.

Key Words: Colostrum, Urea, Nitrogen

M350 Influence of fish/soybean oil supplementation on milk conjugated linoleic acid and mammary gland SCD gene expression in dairy cows. D. P. Bu[1], J. Q. Wang*[1], T. R. Dhiman[2], and S. J Liu[1], [1]*State Key Laboratory of Animal Nutrition,Institute of Animal Science,Chinese Academy of Agricultural Sciences*, *Beijing, China*, [2]*Department of Animal, Dairy and Veterinary Sciences, Utah State University*, *Logan*.

The objective of this study was to examine the effect of adding fish oil and soybean oil to dairy cows on milk fat C18:2 cis-9 trans-11 conjugated linoleic acid (CLA) and mammary gland SCD gene expression. Eighteen Chinese Holstein dairy cows (176 ± 16 DIM) in a randomized design were fed a basal diet (CTL), or basal diet supplemented with either 2% fish oil (FO) or a combination of 2% fish oil and 2% soybean oil (SBFO). The basal diet contained 40% forage and 60% concentrate mix. Oils were added by replacing the corn in the diet. Experimental duration was 9 wk. Diets contained an average 16.6 ± 0.3% CP and had 1.56, 1.64 and 1.72 Mcal NEL/kg DM in CTL, FO and SBFO, respectively. Milk yields were recorded daily and milk samples were collected weekly from 3 consecutive milkings and analyzed for composition and fatty acid (FA) profile. Within each treatment, 3 cows were used for mammary gland biopsy sampling.

Mammary gland tissues were taken from a rear quarter at the end of the treatment period. Relative gene expression data were calculated by $2^{-\Delta\Delta CT}$ method. β-actin was used as the reference gene. Analysis of variance for variables was conducted using the MIXED procedure of SAS. Significance was declared at $P < 0.05$. Feed DMI and milk yields were not different among treatments. Cows in FO and SBFO treatments had 2.50^{b} and 2.86^{b} % fat in milk, respectively compared to 3.63^{a} % in CTL. The proportions of vaccenic acid (VA) and cis-9 trans-11 CLA isomer were 0.75^{b} , 7.88^{a} , and 8.54^{a} , 0.56^{b} , 3.20^{a} and 4.15^{a} percent of total FA methyl esters in CTL, FO and SBFO, respectively. The proportions of unsaturated FA were increased in FO and SOFO treatments compared to CTL. The abundance of SCD mRNA in the mammary gland was reduced by 50% in FO and 57% SOFO compared to CTL. Feeding 2% fish oil (FO) or 2% fish oil plus 2% soybean oil (SBFO) to dairy cows increased the content of VA and CLA in milk by 560% and decreased the milk fat content by 26% compared to CTL without oil.

Key Words: Fish Oil, Conjugated Linoleic Acid, SCD

M351 Flow of fatty acids to the duodenum and fatty acid profile of milk from cows fed diets differing in forage fiber level. D. P. Bu[1], J. Q. Wang*[1], T. R. Dhiman[2], S. C. Li[1], and S. J. Liu[1], [1]*State Key Laboratory of Animal Nutrition,Institute of Animal Science,Chinese Academy of Agricultural Sciences*, *Beijing, China*, [2]*Department of Animal, Dairy and Veterinary Sciences, Utah State University*, *Logan*.

A study was conducted to evaluate the effects of diets differing in forage NDF (fNDF) on the flow of fatty acids (FA) to the duodenum and milk FA profile. Four Holstein cows (483±21kg BW; 175±6 DIM) fitted with permanent ruminal and simple T-shaped cannulae in the proximal duodenum were used in a 4×4 Latin square design experiment. Each period was 21 d. First 2 wk were considered as adaptation to the diets and measurements were made during the last week in each period. Diets in 4 treatments had fNDF content of 46.71(Trt-1), 37.01(Trt-2), 26.43 (Trt-3) and 18.50% (Trt-4) on dry matter basis. The different levels of fNDF in diets were achieved by varying the ratio of forage and concentrate and type of forage. The forages used to formulate diets were corn silage, Chinese wildrye or Alfalfa hay. The diets were formulated to be low-fat. The FA content of the diets was 0.86, 1.14, 1.46 and 1.71 in treatments 1 through 4, respectively. During the last week in each period samples of the rumen fluid and duodenal chyme were collected to study the flow of FA. Milk samples were analyzed for FA profiles. Ruminal fluid pH was 6.56^{a} , 6.55^{a} , 6.45^{a} and 6.26^{b} in treatments 1 through 4, respectively. Decreasing fNDF content of the diets tended to increase the flow of C18:1 trans-11 (VA; $P < 0.09$). The flow of C16:0, C18:0, C18:1 cis-9 and C18:2 to the duodenum increased significantly with decreasing fNDF in the treatment diets. The flow of C18:2 cis-9 trans-11 isomer of conjugated linoleic acid (CLA) was not affected by dietary treatments. Varying the fNDF in the present study had no influence on milk fatty acid profile including CLA content. The results suggest that varying forage NDF content from 46.7 to 18.5 % of diet DM in low fat diets (< 2% of diet) had little effect on milk fatty acid profile

Key Words: Forage, Fatty Acids, Dairy Cow

M352 Fatty acids composition of milk from cows fed oilseeds. S. J. Liu[1], J. Q. Wang*[1], D. P. Bu[1], and T. R. Dhiman[2], [1]*State Key Laboratory of Animal Nutrition, Institute of Animal Science, Chinese Academy of Agricultural Sciences*, *Beijing, China*, [2]*Department of Animal, Dairy and Veterinary Sciences, Utah State University*, *Logan*.

The objective of this study was to examine the influence of oilseeds supplementation on milk fatty acid (FA) profile and plasma parameters in dairy cows. Forty Holstein dairy cows (150 ± 25 DIM) were randomly assigned to four treatments. Cows in four treatments were fed a basal diet (CTL) or basal diet supplemented with either whole soybeans (FS), expanded soybeans (ES), or a mix of whole cottonseed, whole soybeans and expanded soybeans (MIX). Diets contained 1.57, 1.59, 1.60 and 1.64 NEL/kg DM in CTL, FS, ES and MIX treatments. All diets were iso-nitrogenous and contained an average 16.50% CP. Experimental duration was 6 week. Measurements were made during the last 3 weeks. Daily feed intake and milk yield were recorded. Weekly milk samples were analyzed for composition and fatty acid profile. Blood samples were taken from the coccygeal vein or artery at 3h post-feeding on the last day of experiment and analyzed for blood chemistry. Statistical analysis was conducted using the MIXED procedure of SAS for a completely randomized design with repeated measures. Yields of milk, fat and protein were not different among treatments. The proportions of short and medium chain (C4:0 – C12:0) were decreased and long chain FA increased in cows fed oil seeds compared with cows in CTL. Feeding expanded soybeans to cows in ES treatment increased the C18:2 cis-9 trans-11 isomer of CLA in milk by 84% compared with CTL treatment. The concentrations of CLA in milk were the same in CTL, FS and MIX treatments. Mean concentration of plasma cholesterol, lipoprotein cholesterol, NEFA, Leptin, glucose, triglyceride, insulin and β-hydroxybutyric acid was not different among treatments. Results suggest that feeding expanded soybeans to dairy cows enhances the C18:2 cis-9 trans-11 isomer of CLA without influencing feed intake, milk yield, milk composition and blood parameters.

Key Words: Oilseeds, Milk Fatty Acids, Hormones

M353 Please see abstract #282.

M354 Yields of fatty acids in milk of dairy cows fed a high- or low- forage diet supplemented with either flaxseed or flaxseed oil. C. Benchaar*[1], H. V. Petit[1], T. A. McAllister[2], and P. Y. Chouinard[3], [1]*Agriculture and Agri-Food Canada*, *Dairy and Swine R&D Centre, Sherbrooke, QC, Canada*, [2]*Agriculture and Agri-Food Canada*, *Lethbridge, AB, Canada*, [3]*Université Laval*, *Quebec, QC, Canada*.

The objective of this study was to examine the effect of whole flaxseed (FS) and flaxseed oil (FO) supplementation (10 and 3%, respectively; DM basis) on yields of fatty acids in milk of dairy cows fed high- (H) or low- (L) forage diets (70 and 30%, respectively; DM basis). Four lactating cows (BW = 647 kg; DIM = 96 d) used in a 4x4 Latin square design were fed: H+FS (HFS), H+FO (HFO), L+FS (LFS), and L+FO (LFO). Orthogonal contrasts (PROC MIXED, SAS) were used to test the effects of forage level (F), flaxseed source (FLA), and their interaction (F x FLA). Significance was declared at $P < 0.05$. Yields of C18:0 (147.3 vs. 190.8 g/d) and *cis*-9, *trans*-11, *cis*-15 C18:3 (CLNA; 0.78 vs. 1.16 g/d) were lower, and those of C10:0 (37.9 vs. 30.7 g/d), C12:0 (45.2 vs. 33.6 g/d), C14:0 (158.6 vs. 136.1 g/d), C14:1 (14.4 vs. 10.8 g/d), C15:0 (17.4 vs. 14.2 g/d), and *trans*-15 C18:1 (12.9 vs.

9.48 g/d) were higher in milk of cows fed L than in milk of cows fed H diets. Cows fed FS had higher yields of C6:0 (27.8 vs. 24.2 g/d), C8:0 (16.8 vs. 14.3 g/d), C10:0 (37.9 vs. 30.7 g/d), C12:0 (43.4 vs. 35.4 g/d), C16:0 (341.9 vs. 292.8 g/d), C18:0 (179.6 vs. 158.4 g/d), and *cis*-9, *cis*-12, *cis*-15 C18:3 (8.75 vs. 5.74 g/d), and lower yields of *cis*-15 C18:1 (4.67 vs. 7.84 g/d), *trans*-9 C18:1 (3.40 vs. 6.05 g/d), *trans*-11 C18:1 (16.5 vs. 37.7 g/d), *trans*-15 C18:1 (10.1 vs. 12.3 g/d), *cis*-9, *cis*-12 C18:2 (5.21 vs. 14.4 g/d), and *cis*-9, *trans*-11 C18:2 (CLA; 6.10 vs. 14.2 g/d) than cows fed FO. Yield of *trans*-10 C18:1 was 6.83, 3.83, 27.8, and 5.54 g/d for HFO, HFS, LFO, and LFS, respectively (F x FLA). Cows fed FS had higher transfer of *cis*-9, *cis*-12, *cis*-15 C18:3 from feed to milk than cows fed FO (1.63 vs. 1.24%). Feeding L diets modified the pathway of biohydrogenation, leading to higher production of *trans*-10 C18:1 in milk and this effect was of greater magnitude when FO was added in the diet as compared to FS. Feeding FS increased yield and transfer efficiency of *cis*-9, *cis*-12, *cis*-15 C18:3 and decreased the concentration of *trans* intermediates of ruminal biohydrogenation as compared with FO.

Key Words: Flaxseed Oil, Milk Fatty Acid Yield, Dairy Cows

M355 Abomasal infusion of butterfat increases milk fat in lactating dairy cows. A. K. G Kadegowda*, L. S. Piperova, and R. A. Erdman, *University of Maryland*, *College Park*.

Our objective was to compare the effects of abomasal infusion of short and medium chain FA (SCFA) with long chain fatty acids (LCFA) on milk fat synthesis. Eight rumen fistulated Holstein cows, beginning in early lactation (49±20 DIM) were used in a replicated 4x4 Latin square design. Treatments were: 1) Control (C) (no infusion); 2) abomasal infusion of 400g/d butterfat (B); 3) 245 g/d LCFA using a blend of 60% cocoa butter, 30% olive oil, and 10% palm oil that provided equivalent amounts of LCFA found in 400g of B; and 4) CLA (negative control). The CLA mixture provided equal proportions of c9t11 and t10c12 CLA (18% of total CLA; 7.5g/d of t10c12 CLA). Fat supplements were infused in equal portions 3 times daily at 0800, 1400, and 1800 h during the last 2 wks of each 3 wk experimental period. Milk samples for milk composition by infrared analysis were collected from 5 consecutive milkings at the end of wk 3. Daily dry matter intake (DMI) and milk production were unaffected by treatment. Butterfat infusion increased milk fat percentage by 14% ($P < 0.03$) to 4.26% and milk fat yield by 15% ($P < 0.07$) to 1351 g/day compared with Controls (3.74 % and 1175 g/day). CLA infusion decreased milk fat percentage and fat yield by 43% ($P< 0.001$). However, milk protein percentage was higher (3.70%; $P < 0.01$) in CLA infused cows than in Controls (3.30%), butterfat (3.28%) or LCFA (3.27%). While LCFA had no effect on fat synthesis, abomasal infusion of butterfat containing both LCFA and SCFA suggested that the availability of short and medium chain FA may be a limiting factor for milk fat synthesis.

Table 1.

	Treatments					Contrasts (*P*		
Item	C	CLA	B	LCFA	SED	CLA	B	LCFA
DMI, kg/d	23.7	24.1	24.2	25.7	1.10	0.750	0.66	0.09
Milk								
kg/d	31.0	29.9	32.1	33.4	2.28	0.640	0.62	0.30
Fat%	3.74	2.16	4.26	3.79	0.19	0.001	0.03	0.83
Fat yield, g/d	1175	661	1351	1299	102	0.001	0.07	0.19
Protein%	3.30	3.70	3.28	3.27	0.12	0.010	0.86	0.80

Key Words: Butterfat, Milk Fat, Lactating Cows

M356 Evaluation of LYSOFORTE™ PF brand biosurfactant toward enhancing digestion of supplemental dietary fat in animal diets. D. Sapienza[1], F. R. Valdez*[2], A. S. Suleman[2], and W. Rounds[2], [1]*Sapienza Analytica LLC*, *Slater, IA*, [2]*Kemin Industries, Inc.*, *Des Moines, IA*.

Emulsifiers as feed additives improve total-tract digestibility of dietary fats and are especially important in improving fat digestibility when dry distillers grains solubles (DDGS) are fed. An objective of this evaluation was to quantify the increase in the quantity of DDGS that could be digested with the synergistic effects of supplemental emulsifiers. Three different emulsifiers, namely LYSOFORTE™ brand PF (LPC) Biosurfactant, LYSOPRIN, and de-oiled lecithin were evaluated in an *in vitro* anaerobic system with proteases and a lipase. LPC is more effective than either de-oiled lecithin or LYSOPRIN as an aid to digestion of DDGS. The beneficial effects of LPC appear to be more consistent across dosages and levels of DDGS incubated than either de-oiled lecithin or LYSOPRIN. The data suggest that there may be limited benefit in adding an emulsifier when soy oil or tallow is the dietary source of fat but at certain dosages the production of free fatty acids (FFA) was increased when choice grease was incubated with LPC. The concentrations of DDGS ranged from the equivalent of 5 to 30% of the ration dry matter. At the inclusion rate of 5%, the data show that DDGS can be digested (%FATD) above 95% without the aid of an emulsifier. But at inclusion percentages above 14%, %FATD can decrease to 72.2% at the 30% rate. The comparisons of %FATD by dosage reveals that LPC at 250 g/T is significantly better ($P>0.1$) in the number of incidences in which %FATD is equal to or greater than 95%. In contrast, de-oiled lecithin at 250 g/T and LYSOPRIN at 250 g/T have significantly lower instances above 95% and their average %FATD are also significantly lower at 90.4% and 90.8%, respectively. LPC averages 95.7% across all three of its dosages. These data suggest that LPC may be a viable fat digestibility enhancer when DDGS are fed to animal diets greater than 14% of the diet compared to de-oiled lecithin and LYSOPRIN.

Key Words: Dry Distillers Grains Solubles, Fat Digestibility, Lysoforte

M357 Optimizing the levels of linseed oil in grazing cow diets to maximize conjugated linoleic acid in milk. G. D. Flowers*[1], A. A. AbuGhazaleh[1], and S. Ibrahim[2], [1]*Southern Illinois University Carbondale*, *Carbondale*, [2]*North Carolina Agricultural and Technical State University*, *Greensboro*.

In the recent past, there has been considerable interest in the potential health-promoting properties of conjugated linoleic acid (c9t11 CLA), a fatty acid produced naturally in ruminant animals. Previous studies have shown that milk c9t11 CLA increased when cows grazed or fed vegetable oils, however, feeding vegetable oils at higher level can be detrimental to cows. The primary objective of this study was to determine optimum dietary level of linseed oil to increase milk c9t11 CLA for grazing dairy cows. Twelve Holsteins cows in mid lactation were placed on alfalfa based pasture and assigned into four treatment groups using a 4 X4 Latin square design with 3 wk experimental periods. Treatment groups were: 1) control grain supplement; 2) control grain supplement containing 167g linseed oil; 3) control grain supplement containing 333g linseed oil and 4) control grain supplement containing 500g linseed oil. Grain supplements were offered at 7kg/d in two equal feedings after the a.m. and p.m. milking. Additional 100g/day of algae (high in C22:6n3, 40% of total fatty acids) were

added to treatment diets. Milk samples were collected during the last three days of each period and analyzed for composition and fatty acids profile. Treatment diets had no effect on milk production (19.9, 18.8, 19.3, and 20.3 kg/day for diets 1 to 4, respectively), milk fat percentages (3.23, 3.35, 3.36, and 3.31) and milk protein percentages (3.02, 3.1, 3.11, and 3.07). Milk c9t11CLA (1.10, 1.23, 1.43, and 1.65 g/100g fatty acids for diets 1 to 4, respectively), t11 C18:1 (3.28, 3.59, 4.30, and 4.79 g/100g), and C18:3n3 (0.59, 0.78, 1.02, and 1.03 g/100g) concentrations were linearly ($P < 0.05$) increased with linseed oil supplementations. In conclusion, adding linseed oil to grazing dairy cows diet at 500g/d can improve the nutritional value of milk by increasing the levels of milk c9t11 CLA and C18:3n3 without adversely affecting cows milk production or composition.

Key Words: CLA, Linseed Oil, Grazing

M358 Effect of ruminal infusion of sunflower oil (SO) or seeds (SS) combined or not with fish oil (FO) on conjugated linoleic acid (CLA) in milk. G. A. Gagliostro*[1], M. A. Rodriguez[2], P. Pellegrini[2], G. Muset[2], P. Gatti[2], D. A. Garciarena[1], H. H. Fernández[1], M. Oporto[1], A. Ferlay[3], and Y. Chilliard[3], [1]*Instituto Nacional de Tecnología Agropecuaria (INTA)*, *Balcarce, Argentina*, [2]*Instituto Nacional de Tecnología Industrial (INTI)*, *Buenos Aires, Argentina*, [3]*Institut National de la Recherche Agronomique (INRA)*, *Theix, France*.

Four rumen cannulated Holstein cows grazing a pasture (Avena sativa, L.) received according to a 4×4 Latin square design four corn silage-based diets supplemented with sunflower seeds (SS, 1.9 kg DM/cow/d); sunflower oil (SO, 0.8 kg/cow/d); SS plus fish oil (SS-FO, SS + 0.24 kg/cow/d FO) or SO-FO (SO + 0.24 kg/cow/d FO). Corn silage and corn grain were fed at 5.6 and 1.3 kg DM/cow/d. SO treatments were balanced for CP by adding 0.89 kg DM/cow of sunflower meal. Oils and seeds (coarsely ground) were introduced via ruminal cannulae. Statistical analysis included effects of cow, period, linoleic source, FO supply and the interaction. Duncan's Multiple Range Test was used to compare (SS + SS-FO) vs (SO + SO-FO) and (SS +SO) vs (SS-FO + SO-FO). Pasture, SO and FO represented 39, 5.6 and 1.6% of total DMI. . Interaction effects were not detected. Milk yield tended ($P<0.07$) to increase with SO (9.9 vs 8.7 kg/d). FCM (8.01 vs 6.37 kg/d) and milk fat (270 vs 191 g/d) yields increased ($P<0.04$) with SO. Content (40.5 vs 37.0 g/kg) and yield (397 vs 322 g/d) of milk protein were higher ($P<0.01$) in SO treatments. Parameters of pasture NDF degradation did not differ. Soluble CP fraction of pasture increased ($P<0.04$) from 31.3% up to 49.6 % when FO was fed. Ruminal pH was higher ($P<0.05$) in SS-FO (6.07) compared to SO-FO (5.77). SS or SO alone or combined with FO decreased concentrations (g/100g FA) of de novo synthesized saturated FA (-1.59 for C12:0, -4.79 for C14:0 and -8.29 for C16:0, vs pre-experimental period). C18:0 was 14.1 in SS and SO vs 6.42 g/100g FA in SS-FO and SO-FO ($P<0.002$). Trans-C18:1 was higher ($P<0.001$) in FO groups (30.7) compared to SS and SO (13.9) and particularly with SS-FO (33.5; $P<0.05$). Cis-9 C18:1 decreased (-12.6 g/100g FA) with FO ($P<.0001$). Increase of 9-cis 11-trans CLA over baseline averaged 2 g/100g FA across treatments. FO supply increased CLA content from 2.86 up to 3.92 g/100g FA ($P<0.04$) and increased the C18:3n-3 (+0.34 g/100g FA, $P<0.0003$). Unsaturated FA supply had a marked effect on milk FA profile. However the increase in trans-C18:1 isomers with FO and their implications on human health need to be determined.

Key Words: Conjugated Linoleic Acid, Sunflower, Fish Oil

M359 Effects of high oil corn grain supplementation on milk yield and composition and milk fatty acid profile in grazing dairy cows in early lactation. F. Luparia[1], D. A. Garciarena[1], C. A. Cangiano[1], P. Pellegrini[2], M.A. Rodriguez[2], H. H. Fernández[1], and G. A. Gagliostro*[1], [1]*Instituto Nacional de Tecnología Agropecuaria, INTA*, *Balcarce, Buenos Aires, Argentina*, [2]*Instituto Nacional de Tecnología Industrial, INTI*, *Buenos Aires, Argentina*.

The objective was to evaluate the effect of high oil corn grain (HOC, 6.6% ether extract) vs conventional corn (CC, 2.25 % ether extract) at two feeding levels (4 and 8 kg/cow/d) on yield, composition and fatty acid (FA) profile of milk in grazing dairy cows. Four ruminal cannulated Holstein cows in early lactation (30 days in milk) grazed a pasture in 4x4 Latin square design with a 2x2 factorial arrangement of treatments. Each experimental period lasted 14 days (d). The first 10 d were used for adaptation to diets with the last 4 d for data collection. Herbage allowance was fixed at 11 and 17 kg pasture DM/cow/d when 8 and 4 kg of grain were consumed. Cows received 2 kg/d of soybean meal and 0,15 kg/d of a mineral-vitamin premix. Milk yield (25.5 kg/cow/d), FCM (21.9 kg/cow/d), milk fat (30.8 g/kg) and milk protein contents (31.2 g/kg) did not differ between treatments. Concentration of C12:0 and C14:0 in milk-fat resulted lower ($P<0.01$) in HOC (2.70 and 24.51 g/100 g FA) than CC (3.15 and 25.85 g/100 g FA). A significative corn level x genotype interaction was detected for C16:0 concentration. It was lower in HOC groups (24.51 g/100 g FA) compared to CC (25.85 g/100 g FA) and particularly to HOC8 (24.04 g/100 g FA). Concentration of vaccenic acid (trans-11 C18:1) in milk-fat was higher with 4 kg (3.20 g/100 g FA) instead of 8 kg (2.81 g/ 100g FA) feeding level of corn grain without genotype effect. Content of 9c, 11t CLA resulted higher ($P<0.02$) in cows that ingested 4 kg (1.28 g/100 g FA) instead of 8 kg (1.08 g/ 100g FA) of corn grain. Neither the level nor the genotype of supplemental corn grain affected yield and composition of milk. Feeding HOC grain slightly reduced the concentration of C12, C14 and C16 FA in milk without effects on milk CLA content. Milk CLA concentration was decreased with the highest corn grain intake.

Key Words: High Oil Corn, Conjugated Linoleic Acid, Grazing Dairy Cows

M360 Evaluation of the effects of dietary fat supplement on conjugated linoleic acid (CLA) in milk fat of dairy cows: A meta-analysis approach. A. Nudda, C. Dimauro, A. Mereu, N. P. P. Macciotta*, and A. Cappio-Borlino, *Dipartimento di Scienze Zootecniche - University of Sassari*, *Sassari, Italy*.

Diet has been widely recognized as the most important factor influencing milk CLA content in ruminant milk. However results of experiments carried out the effects of dietary fat supplementation on milk CLA content in dairy cows are remarkably variable. In this work, a meta-analysis has been carried out to analyze the results from different studies designed to evaluate the effects of different fat sources and different amount of dietary fat on milk CLA content in dairy cows. Data were extracted from 51 feeding trials published in Pubmed, ScienceDirect and proceedings of scientific meetings, updated through January 2007. Data on milk CLA content were analyzed with a linear mixed model that included the content of fat supplemented in the diet, the type of fatty acid predominant in the fat source, the physical form of the supplemented fat, the forage/concentrate ratio as fixed effects. Moreover, the study has been included as a block random variable. Results highlighted a significant effect on milk CLA content of the

type of fatty acid predominant in the dietary fat source and of the physical form of the lipid supplement. In particular, the fish oil results in the highest CLA concentration in milk, whereas the saturated fatty acids (C18:0+C16:0) are the less efficient. As far as the physical form of supplement is concerned, the highest milk CLA content is observed when oil and mix of oil with other fat are used. Finally, the content of fat in the diet and the forage/concentrate ratio does not show significant effects on milk CLA content. In conclusion, results of the meta-analysis confirms the assessed knowledge about main nutritional factors that influence the milk CLA content but some points are raised on the usefulness of some nutritional strategies that have been recommended to obtain appreciable increases of milk CLA content.

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Key Words: CLA, Dairy Cow, Meta-Analysis

M361 Milk conjugated linoleic acid response to fish oil and sunflower oil supplementation to dairy cows managed under two feeding systems. D. O. Felton* and A. A. AbuGhazaleh, *Southern Illinois University*, *Carbondale*.

Conjugated linoleic acid (CLA) is a generic term used to describe positional and geometric isomers of octadecadienoic fatty acids (FA) containing conjugated double bonds. CLA have been of keen interest since it was discovered that some have potential human health benefits. Earlier research has showed that cis-9, trans-11 CLA level in milk fat is highest when cows diets are supplemented with a blend of fish oil (FO) and linoleic acid-rich oil. The objective of this study was to determine the effect of FO and sunflower oil (SFO) supplementation to dairy cows fed fresh or conserved forage-based diets on milk cis-9, trans-11 CLA. Fourteen cows in midlactation were split into two treatment groups and fed the treatment diets for 3 wk. Cows in group one were fed corn silage-alfalfa hay mix ad libitum (L) while cows in group two grazed on alfalfa-grass pasture (P). Both groups were supplemented with 8kg grain supplement containing 640g of FO and SFO (1:3 w/w). Grain supplement was fed in two equal feedings after the AM and PM milkings. Milk samples were collected during the last 3 days. Compared with the L group, the P group saw a large decrease ($P < 0.05$) in milk production (25.8 and 16.8kg/d for L and P, respectively). Milk fat percentages (2.18 and 3.16) were lower ($P < 0.05$) in L compared with P treatment, however, milk fat yield (0.55 and 0.52kg/d) was similar ($P > 0.05$) for both treatments. Milk protein percentages were not affected ($P > 0.05$) by treatment diets (3.27 and 3.41) but protein yield (0.80 and 0.55kg/d) was lower ($P < 0.05$) for P compared with L treatment. Concentrations and yields of vaccenic acid (2.15 and 4.52g/100g of FA; 10.8 and 18.3g/d for L and P, respectively) and cis-9, trans-11 CLA (0.84 and 1.52g/100g FA; 4.0 and 6.1 g/d for L and P, respectively) in milk fat were higher ($P < 0.05$) with P compared with L treatment. Milk fat trans-10 C18:1 concentration (4.99 and 1.69g/100g FA) and yield (23.4 and 7.4g/d) were higher ($P < 0.05$) with L compared with P treatment. In conclusion, milk cis-9, trans-11 CLA content was higher when FO and SFO were supplemented with fresh forage-based diet.

Key Words: CLA, Oil, Forage

M362 Effects of feeding increasing amounts of a lipid-encapsulated conjugated linoleic acid (CLA) supplement on periparturient cows. J. W. Wheelock*[1], L. L. Hernandez[1], S. R. Sanders[1], M. J. de Veth[2], and L. H. Baumgard[1], [1]*University of Arizona*, [2]*BASF AG*, *Germany*.

Compared to established lactation, *trans*-10, *cis*-12 CLA is less effective at reducing milk fat synthesis during the first few weeks postpartum. Therefore, to induce milk fat depression and improve bioenergetic variables a much larger CLA dose is necessary. Objectives of this small preliminary trial were to evaluate the transfer of dietary *trans*-10, *cis*-12 CLA into milk fat and utilize those concentrations to predict effects on mammary lipid metabolism and production variables. Multiparous Holstein cows (n = 15) were randomly assigned to one of four supplemental CLA doses (0, 50, 250 and 500 g/d) with each dose providing either 0, 5, 25, or 50 g of *trans*-10, *cis*-12 CLA/d, respectively. *cis*-9, *trans*-11 was the only other CLA isomer in the supplement and was at a similar content as the *trans*-10, *cis*-12 CLA isomer. Each group received treatments (top-dressed) from -10 to 21 d relative to calving. Milk yield and feed intake were recorded daily, and milk samples obtained from each cow on 2, 4, 6, 8, 10, 15 and 20 DIM. Milk samples from 2, 8 and 20 DIM were analyzed for milk fatty acid composition. Results were analyzed as repeated measures using PROC MIXED of SAS. There were no overall differences in milk yield (35.6 kg/d), DMI (17.1 kg/d), protein% (3.61), lactose% (4.43), SNF (9.01) or SCC (355 x 1000). The 50 g/d dose did not significantly effect milk fat levels, but the two largest CLA doses decreased overall milk fat content by >17%. Milk fat *trans*-10, *cis*-12 CLA content averaged 0.13, 0.27, 0.76 and 1.42 mg/g fatty acids and milk *cis*-9, *trans*-11 followed a similar dose responsive ($P< 0.05$) pattern. Milk fat 18:1 *trans*-10 content averaged 3.35, 3.43, 3.48 and 4.57 mg/g, but treatment had no effect on other 18:1 trans-monoenes. Both CLA isomers and the 18:1 *trans*-10 milk fat content were temporally independent. Data from this small preliminary trial indicate a large dose of lipid-encapsulated CLA supplement delivers an amount of *trans*-10, *cis*-12 CLA necessary to reduce milk fat synthesis during the transition period.

Key Words: CLA, Transition Cows

M363 Effect of diets enriched with oleic, trans-octadecenoic, linoleic, or linolenic acids on gene expression of liver tissue from early postpartum lactating Holstein cows. B. C. do Amaral*, C. R. Staples, L. Badinga, S. A. Sennikov, and W. W. Thatcher, *University of Florida*, *Gainesville*.

The objective was to evaluate how dietary fat sources of oleic, trans-octadecenoic, linoleic, or linolenic acids affected gene expression of pyruvate carboxylase (PC), phosphoenolpyruvate carboxykinase (PEPCK), IGF–2, IGFBP–2, and IGFBP–3 in the liver of Holstein primiparous (n = 12) and multiparous (n = 20) cows during the summer season. Fat supplements were the following: 1) sunflower oil (SFO; Trisun, Humko Oil, 80% C18:1), 2) Ca salt of trans-octadecenoic acids (TRANS; EnerG TR, Virtus Nutrition, 57% trans 6–12 C18:1), 3) Ca salt of vegetable oils (CaVeg; Megalac–R, Church & Dwight Co, 29% C18:2), and 4) linseed oil (LSO; Archer Daniels Midland, 56% C18:3 and 16% C18:2). Supplemental fats were fed at 1.35% of dietary DM beginning at 30 ± 7 d prior to expected calving date. After calving, fat supplements were fed at 1.5% (oils) and 1.75% (Ca salts) of dietary DM for 15 wk. Liver samples were taken via biopsy on 2, 14 ± 1, and 28 ± 1 DIM. Abundance of PC mRNA decreased linearly whereas that

of PEPCK mRNA increased linearly over time across diets. Abundance of PC and PEPCK mRNA increased over time in livers of cows fed LSO but decreased in those of cows fed CaVeg. Primiparous cows had a greater abundance of IGF–2 and IGFBP–2 mRNA in the liver compared to multiparous cows. Hepatic content of IGF–2 mRNA did not change over DIM in cows fed LSO but was maximal at 14 DIM in cows fed CaVeg (LSO vs. CaVeg by DIM interaction). Expression of IGFBP–2 increased from 2 to 14 DIM but decreased at 28 DIM, with the decrease being greater for liver of cows fed the monounsaturated fats (MUFA) compared to the polyunsaturated fats (PUFA) (MUFA vs. PUFA by quadratic DIM interaction). Likewise, hepatic expression of IGFBP–3 was only different at 28 DIM with cows fed MUFA expressing less IGFBP–3 than those fed PUFA. Supplemental fat source influences hepatic gene expression of the gluconeogenic enzymes as well as the IGF system.

Key Words: Fat, Liver, Gene Expression

M364 Please see abstract #279.

M365 Effects of abomasal infusion of water linseed oil or tallow on responses to glucose and insulin challenges in feed restricted Holstein cows. J. A. A. Pires*, J. B. Pescara, N. Silva del Rio, A. P. Cunha, and R. R. Grummer, *University of Wisconsin*, *Madison*.

The objective was to test the effects of abomasal infusion of water (**W**), linseed oil (**L**) or tallow (**T**) on responses to i.v. glucose tolerance tests (**IVGTT**; 0.25g dextrose i.v. bolus/kg BW) and insulin challenges (**IC**; 0.1 IU insulin i.v. bolus/kg BW) in feed restricted Holstein cows. Six non-lactating, non-gestating cows were assigned to a replicated 3 × 3 Latin square design, and infused with W, L or T at a rate of 0.54 g/d per kg BW, for 5.5 d. Cows were fed to meet maintenance requirements for the first 72 h of each period, and were feed restricted thereafter to stimulate body reserve mobilization. IVGTT were performed on d 5, 50 h after initiation of feed restriction, followed by IC 12 h later. Contrasts were: 1) W vs. fat; 2) L vs. T. Before IVGTT, plasma glucose was 58, 61 and 58 ± 1.3 mg/dL (L vs. T; $P = 0.09$), serum insulin was 12.3, 11.8 and 12.5 ± 1.3 µIU/mL, and plasma NEFA was 548, 612 and 508 ± 44 µEq/L (L vs. T; $P = 0.09$) for W, L and T respectively. There were no treatment differences in glucose or insulin response to IVGTT. NEFA clearance rate was 2.6, 2.8 and 2.5 ± 0.1 %/min (L vs. T; $P = 0.06$), time to reach half concentration was 27, 25 and 29 ± 1.3 min (L vs. T; $P = 0.04$), and NEFA response area under the curve (**AUC**) was -52187, -64150 and -46402 ± 5871 (\mu;Eq/L)*180 min (L vs. T; $P = 0.04$) for W, L and T, respectively. Before IC, plasma glucose was 59, 60 and 60 ± 1.5 mg/dL, serum insulin was 10.1, 8.7 and 9.6 ± 1.3 \mu;IU/mL, and plasma NEFA was 689, 764 and 664 ± 72 \mu;Eq/L for W, L and T respectively. There were no differences in glucose and insulin response after IC. NEFA AUC was -16338, -18275 and -13817 ± 5034 (µEq/L)*30 min (L vs. T; $P = 0.12$) for W, L and T respectively. Supplementation of L, rich in C18:3, may enhance insulin antilipolytic effects in adipose tissue of Holstein cows as compared to T. However, plasma NEFA immediately before IVGTT and IC was approximately 100 µEq/L greater for L than T for unknown reasons.

Key Words: Linseed Oil, NEFA, Insulin Resistance

M366 Effect of vitamin E or vitamin C on *in vitro* biohydrogenation of linolenic and linoleic acid in the presence of unesterified DHA. C. Boeckaert*[1], K. Ardvisson[2], N. Boon[1], and V. Fievez[1], [1]*Ghent University*, *Melle, Belgium*, [2]*Swedish University of Agricultural Sciences*, *Umeå, Sweden*.

Unesterified DHA was shown to inhibit the production of C18:0 in the rumen from dietary linolenic (C18:3 n-3) or linoleic (C18:2 n-6) acid. The current study investigated whether supplementation of vitamin E or C could prevent this inhibition. *In vitro* incubations with 50 ml buffered rumen fluid were performed to study the effect of unesterified DHA (21.5 mg) either or not supplemented with lipid soluble vitamin E or water soluble vitamin C on rumen biohydrogenation of C18:3 n-3 from grass silage (0.8 g) and C18:2 n-6 from sunflower oil (20 mg). Vitamin E was supplemented as DL-all-rac-α-tocopherol (5 mg) and vitamin C as ascorbic acid (5 mg). After 6 h of incubation, DHA supplemented flasks contained significantly ($P < 0.05$) higher amounts of C18:3 n-3, C18:2 t11c15, CLA c9t11 and C18:1 t11 whereas C18:3 c9t11c15 and C18:0 significantly decreased. No significant difference in C18:2 n-6, CLA t10c12 and C18:1 t10 concentrations were observed between control and DHA supplemented treatments. Vitamin addition did not prevent DHA to inhibit rumen biohydrogenation as the accumulation of hydrogenation intermediates did not significantly differ between DHA supplemented incubations either with or without vitamin addition. DHA also shifted rumen fermentation, significantly depressing acetate and CH_4 productions whereas propionate and butyrate productions significantly increased in comparison to the control treatment without DHA supplementation. The overall volatile fatty acid production was not affected by DHA. The relative CH_4 productions for incubations supplemented with vitamin E or vitamin C were intermediate ($P < 0.05$) between the control and the DHA treatments. This indicates that the inhibition of rumen methanogenesis induced by DHA can partially be prevented by both vitamins. In conclusion, vitamin E or vitamin C supplementation could not prevent the inhibitory effect of unesterified DHA on rumen biohydrogenation, which indicates that the latter effect is not provoked by oxidation of DHA.

Key Words: Biohydrogenation, DHA, Vitamin

M367 Effect of dietary polyunsaturated fatty acids on the expression of genes involved in prostaglandin biosynthesis in the bovine uterus. S. M. Waters[1], S. Childs[1,2], J. M. Sreenan[1], A. A. Hennessy[2], C. Stanton[2], and D. A. Kenny*[3], [1]*Teagasc, Animal Production Research Centre, Mellows Campus*, *Athenry, Co. Galway, Ireland*, [2]*Teagasc Dairy Products Research Centre*, *Fermoy, Co. Cork, Ireland*, [3]*School of Agriculture, Food Science & Veterinary Medicine, University College Dublin*, *Belfield, Dublin 4, Ireland*.

Nutrition plays a critical role in the regulation of cow fertility and there is emerging evidence that dietary omega-3 polyunsaturated fatty acids (ω-3 PUFA) may act as potent regulators of the reproductive process. *In-vitro* studies have demonstrated that the ω-3 PUFAs, eicosapentaenoic acid (EPA) and docosahexaenoic acid (DHA) play pivotal roles in the suppression of uterine derived prostaglandin F2α synthesis, a critical regulator of embryo survival, though the biochemical mechanisms involved are as yet unclear. The objective of this study was to determine the effect of dietary supplementation of ω-3 PUFA on mRNA expression of key uterine endometrial genes involved in PGF2α biosynthesis. Beef heifers were fed either a high or low ω-3 PUFA diet, generating, in turn, combined uterine endometrial

concentrations of EPA and DHA which were more than two-fold higher (P <0.05), and EPA concentrations alone that were more than fourfold higher (P < 0.01) in the high and low supplemented animals, respectively. Total RNA was isolated from endometrial tissue and real-time RT PCR was carried out to measure the relative expression of 10 genes known to be involved in the prostaglandin biosynthetic pathway. Expression of mRNA for prostaglandin E synthase (PGES) and the peroxisome proliferator-activated receptors, PPAR α and δ was increased in animals fed the high compared with low ω-3 PUFA diet (P<0.05). There was a tendency for the mRNA expression of phospholipase A2 (PLA2), to be down-regulated (P=0.08). In conclusion, bovine endometrial gene expression of PGES, PPAR α, PPAR δ and PLA2 is differentially regulated in response to long chain ω-3 PUFA supplementation, suggesting a possible mechanism by which PUFAs may influence uterine function and in turn embryo survival.

Key Words: ω-3 PUFA, Gene Expression, Bovine Endometrium

M368 Effect of electron beam irradiation on ruminal DM and NDF degradation characteristics of wheat and barley straws. A. A. Sadeghi*[1] and P. Shawrang[2], [1]*Department of Animal Science, Faculty of Agriculture, Science and Research Branch, Islamic Azad University*, *Tehran, Iran*, [2]*Animal Science Research Section, Research Center for Agriculture and Medicine, Atomic Energy Organization of Iran*, *Karaj, Iran*.

The present study was designed to evaluate the effects of electron beam irradiation at doses of 100, 200 and 300 kGy on ruminal DM and NDF degradation characteristics of wheat straw (WS) and barley straw (BS). Duplicate nylon bags of untreated and treated straws were suspended into the rumen of four non-lactating Holstein cows for 0, 8, 12, 24, 48, 72 and 96-h. Immediately after submersion of the 0 h bags of substrate into the ruminal fluid, all bags were removed and rinsed with an automatic washing machine. Bags were then freeze dried, weighed and analysed for chemical composition. Data were fitted to exponential model to calculate degradation parameters of DM and NDF. The degradability parameters for the nylon bags analyzed as a randomized complete block design, using cows as blocks. Data were analyzed with the general linear model of SAS (1996). Differences among treatments were separated using polynomial orthogonal contrasts to determine linear, quadratic, and cubic responses. Electron beam had no effect on CP, ash and ether extract contents, but decreased NDF and ADF contents of both straws as irradiation dose increased. There was a linear increase (P<0.001) in the wash-out fraction and a linear decrease (P<0.001) in the potentially degradable fraction of DM and NDF. The degradation rate of the latter fraction increased linearly (P<0.001) as irradiation dose increased. The effective DM and NDF degradability of 100, 200 and 300 kGy irradiated WS at an outflow rate of 0.05/h increased by 18 and 15; 31 and 27; and, 43 and 38%, compared to untreated WS, and for 100, 200 and 300 kGy irradiated BS increased by 21 and 19; 36 and 33; and, 48 and 43% compared to untreated BS, respectively.

Key Words: Electron Beam, Wheat and Barley Straws, Ruminal Degradability

M369 Delta 9 desaturase gene expression in muscle, adipose tissue and liver of beef heifers following supplementation of grass with a concentrate containing sunflower seed and fish oil. S. A. McGettrick*[1], A. P. Maloney[2], F. J. Monahan[1], T. Sweeney[1], and F. J. Mulligan[1], [1]*Veterinary Sciences Centre, School of Agriculture, Food Science and Veterinary Medicine*, *University College Dublin, Belfield, Dublin 4, Ireland*, [2]*Teagasc, Grange Research Centre*, *Dunsany, Co. Meath, Ireland*.

In ruminant tissues delta 9 desaturase is involved in the endogenous synthesis of conjugated Linoleic acid (CLA) from vaccenic acid (VA), formed during rumen microbial biohydrogenation of Linoleic and Linolenic acid. Previous experiments have shown that dietary sunflower and fish oil inclusion increase CLA levels in bovine tissue. The objective of this experiment was to examine the effects of grazed grass or concentrates either alone or supplemented with sunflower seed (SFS) and fish oil (FO) on the expression of the delta 9 desaturase gene in liver, adipose tissue and muscle of fattening beef heifers. Forty Charolais or Limousin crossbred heifers of similar nutritional history were assigned to two outdoor and two indoor groups (n=10). The outdoor animals were offered unsupplemented pasture (*Lolium Perenne*), or restricted pasture with 2.5kg of a supplement containing SFS (29%) and FO (6%). Indoor groups were fed a basal concentrate rich in linolenic acid (32% of total fatty acids) or restricted basal concentrate with 2.5kg of the SFS and FO based supplement. Animals were slaughtered after 150 days on experimental treatments. Samples of subcutaneous adipose, liver and muscle were collected within 45 minutes of slaughter and stored at -70°C before total RNA extraction using RNAeasy kits (Qiagen). RNA extracts were quantified spectrophotometerically and c-DNA was synthesized using Invitrogen Superscript III First-Strand Synthesis System for RT-PCR. Quantities of mRNA were determined relative to 18S-RNA using quantitative real time-RT PCR and analysed using the GLM procedure of SAS. Delta 9 desaturase mRNA levels were lower (P<0.05) in muscle and subcutaneous adipose of grass-fed animals compared to concentrate-fed animals but were unchanged in liver (P>0.05). Supplementation of the diet with SFS and FO had no effect on delta 9 desaturase gene expression in any tissue. These results show that grass-based diets result in lower delta 9 desaturase gene expression in muscle and adipose tissue of beef animals despite increasing overall CLA levels in the tissues.

Key Words: CLA, Delta 9 Desaturase, Beef

M370 Effect of level and duration of dietary ω-3 polyunsaturated fatty acid supplementation on Δ-9 desaturase gene expression in muscle of beef cattle. S. M. Waters[1], J. P. Kelly[2], P. O Boyle[1], A. P. Moloney[3], and D. A. Kenny*[2], [1]*Teagasc, Animal Production Research Centre, Mellows Campus*, *Athenry, Co. Galway, Ireland.*, [2]*School of Agriculture, Food Science & Veterinary Medicine, University College Dublin*, *Belfield, Dublin 4, Ireland*, [3]*Teagasc, Grange Beef Research Centre*, *Dunsany, Co. Meath, Ireland.*

Supplementation of cattle diets with a blend of oils rich in omega-3 polyunsaturated fatty acids (ω-3 PUFA) and linoleic acid has a synergistic effect on the accumulation of ruminal and tissue concentrations of vaccenic acid, the main substrate for tissue synthesis of the cis9, trans11 isomer of conjugated linoleic acid (CLA), via Δ-9 desaturase. However, concentrations of CLA in muscle of beef animals have not always been increased. The objective of this study was to investigate the effect of level and duration of feeding a high ω-3

fishoil (FO) supplement in combination with soyaoil (SO) on the gene expression of Δ-9 desaturase in muscle. Beef bulls (n=48) were assigned to one of four isolipid and isonitrogenous dietary treatments. Diets contained one of the following: (i) 6% SO (CON); (ii) 6% SO + 1% FO (FO1); (iii) 6% SO + 2% FO (FO2) or (iv) 8% palmitic acid for first 50 days and 6% SO + 2% FO for the latter 50 days (FO2(50)). Samples of *M. longissimus dorsi* were harvested. Concentrations of a range of fatty acids were measured. Total RNA was isolated and the relative expression of mRNA for Δ-9 desaturase was determined. Expression of mRNA for Δ-9 desaturase was decreased 2.6, 4.1 and 4.6 fold in FO1, FO2(50) and FO2 treatment groups compared with CON, respectively ($P<0.05$). Increasing the level of dietary FO from 1% to 2%, resulted in a further repression of Δ-9 desaturase mRNA expression ($P=0.09$). Extending the duration of supplementation by 50 days did not affect mRNA expression ($P=0.24$). Regression analysis displayed a negative relationship between tissue concentration of ω-3 PUFA and Δ-9 desaturase gene expression ($P<0.05$). Simultaneous enhancement of both CLA and ω-3 PUFA concentrations in bovine muscle may be hindered by negative interactions between dietary ω-3 PUFA supplementation and tissue Δ-9 desaturase gene expression.

Key Words: Δ-9 Desaturase, Gene Expression, Bovine Muscle

M371 Body condition score and day of lactation affect lipogenic mRNA abundance and transcription factors in adipose tissue of beef cows fed supplemental fat. C. M. Murrieta*, S. L. Lake, E. J. Scholljegerdes, B. W. Hess, and D. C. Rule, *University of Wyoming*, *Laramie*.

We hypothesized that BCS at parturition and postpartum dietary fat supplementation will alter transcription factors and mRNA abundance of adipose tissue lipogenic and lipolytic enzymes during lactation in beef cows. Our objective was to determine abundance of mRNA for acetyl-CoA carboxylase (ACC), hormone-sensitive lipase (HSL), and lipoprotein lipase (LPL), and transcription factor levels in adipose tissue of 3-yr old Angus × Gelbvieh beef cows nutritionally managed to achieve a BCS of 4 ± 0.07 (BW = 479 ± 36 kg; n = 18) or 6 ± 0.07 (BW = 579 ±53 kg; n = 18) at parturition. Beginning 3 d postpartum, cows within each BCS were assigned to isonitrogenous and isocaloric diets of hay plus low-fat control supplement, or supplements (5% of DMI as fat) with either cracked high-linoleate or cracked high-oleate safflower seeds until d 60 of lactation. At d 30 and d 60 of lactation, s.c. adipose tissue biopsies were collected for RNA extraction, quantitative RT-PCR determination of transcript abundance, and Western blot analysis for STAT-5 and PPAR-γ. Adipose tissue of BCS 4 cows had less mRNA for LPL ($P = 0.001$) and HSL ($P = 0.09$) compared with BCS 6 cows. Abundance of LPL mRNA was lower ($P = 0.002$) at d 30 postpartum compared with d 60; whereas, HSL mRNA was greater at d 30 ($P = 0.001$). Cow BCS did not affect ($P = 0.35$) ACC mRNA; however, it tended to be higher ($P = 0.13$) at d 60 compared to d 30 of lactation. Abundance of PPAR-γ tended ($P = 0.13$) to be lower in adipose tissue of BCS 4 cows compared with BCS 6 cows. Both STAT-5 ($P = 0.0001$) and PPAR-γ ($P = 0.05$) were higher at d 30 compared to d 60 postpartum. We conclude that abundance of adipose tissue mRNA for LPL and HSL are influenced by cow BCS, and changes in mRNA abundance during lactation indicates a shift in nutrient partitioning away from the mammary gland to s.c. adipose tissue. Furthermore, STAT-5 and PPAR-γ likely play a role in the transcription regulation of LPL and HSL in adipose tissue during lactation in beef cows.

Key Words: Adipose, mRNA, Lactation

M372 Modeling fatty acid kinetics in plasma and immune cells of neonatal calves in response to increasing levels of dietary fish oil. M. A. Ballou*, J. G. Fadel, and E. J. DePeters, *University of California*, *Davis*.

Mathematical descriptions of the changes in FA composition of immune cells and plasma were determined in calves fed a commercial milk replacer supplemented with additional lipid. 15 Jersey calves (6 ± 1 d old) were completely randomized to one of 3 treatment diets, which were altered by supplementing 2% of a milk replacer with FA from various sources. Treatments included a control (3:1 blend of corn and canola oils), a 1:1 mix of fish oil (FO) and the control blend, and FO only. On d 0, 7, 14, 21, and 42 blood was collected and plasma and peripheral blood mononuclear cells (PBMC) were fractionated for FA analyses of phospholipids. Parameter estimations, the rate of incorporation and the proportional change in the FA composition when a relative asymptote was reached, were determined for each calf using non-linear procedures of SAS. ANOVA of parameter estimates were performed and simple linear regression analyses were carried out to describe the dose response relationship to dietary FO. All data are reported from the PBMC pool as arachidonic acid (AA), eicosapentaenoic acid (EPA), and docosahexaenoic acid (DHA). In control calves, AA, EPA, and DHA all decreased during the neonatal period. Concentrations at d 0 (19.4, 0.46, and 1.47 g / 100 g FA), the proportional decrease from d 0 to asymptote (19.3, 66.6, and 35.5 %), and the relative half lives (6.0, 3.2, and 4.0 d) are reported. Supplementing FO to neonatal calves increased EPA and DHA incorporation into PBMC; linear regression analyses of EPA ($r^2 = 0.825$) and DHA ($r^2 = 0.861$) revealed the linear relationship between concentration in diet and PBMC. Supplementing FO tended ($P < 0.08$) to linearly decrease AA. The relative half lives of AA, EPA, and DHA did not differ with level of dietary FO; however, across FO treatments the half lives were markedly different (6.2, 30.5, and 8.4 d). The impacts of decreased polyunsaturated FA composition of neonatal PBMC are unknown. These data demonstrate that dietary strategies to alter immune cell FA composition by supplementing FO require adaptation periods of weeks to months to reach a new steady state.

Key Words: Immune, Fatty Acid, Kinetic

M373 Effects of soybean oil plus additional forage and anabolic implant on performance, carcass quality, and meat CLA content in finished steers. V. Poulin*[1], A. Fournier[2], J. Jacob[3], C. Gariépy[4], C. Avezard[4], N. Durand[4], J. Fortin[4], and P. Y. Chouinard[1], [1]*Institut des nutraceutiques et des aliments fonctionnels, Université Laval*, *Québec, Qc, Canada*, [2]*MAPAQ*, *Nicolet, Qc, Canada*, [3]*MAPAQ*, *St-Narcisse, Qc, Canada*, [4]*CRDA, Agriculture and AgriFood Canada*, *St-Hyacinthe, Qc, Canada*.

One hundred twenty crossbred steers (9 mo of age; 336 kg BW) were allotted to six weight replicates. Within each replicate, steers were allotted to one of four pens in a randomized complete block design (5 head per pen, 24 total pens). Treatments were low forage control diets (LFC) or high forage diets supplemented with soybean oil (HFO), without (NI) or with anabolic implant (Revalor S) (I) in 2x2 factorial arrangement. Growing diets fed for 63 d were based (DM basis) on wet grass hay (22.9 and 33.7% for LFC and HFO, respectively) corn silage (19.3 and 27.9%), ground corn (52.7 and 28.5%), soybean meal (3.0 and 3.4%), and soybean oil (0 and 4.6%). Finishing diets fed from day 64 to slaughter (4-10 mm backfat, 600 kg BW) were based on wet grass hay (14.0 and 21.2%) corn silage (14.2 and 21.5%), ground corn

(66.9 and 47.3%), soybean meal (2.9 and 3.6%), and soybean oil (0 and 4.3%). Steers were implanted at the beginning of the growing and the finishing phases. The HFO diets resulted in 12.6% lower ADG, 2.2% lower carcass yield, and 19.4% lower s.c. fat thickness at slaughter (P<0.01). Implant increased ADG by 26%, feed efficiency by 16%, carcass yield by 2.1%, BW at slaughter by 5.4%, and carcass weight by 7.5% (P<0.01), but decreased s.c. fat thickness by 13% (P=0.02). Warner-Bratzler shear force of the longissimus dorsi (l.d.; 3 steers per pen) was 33% higher (P<0.01) for I than for NI, which was confirmed by a 23% higher firmness score for I than for NI (P<0.01) as rated by a trained sensory panel (8 steers per treatment). Total fatty acid (FA) content of l.d. (2 steers per pen) were lower (P<0.01) with HFO as compared to LFC (-21%), and with I as compared to NI (-41%). Conjugated linoleic acid (CLA) concentration (% by weight of total FA) in intramuscular fat was 140% greater in HFO than in LFC. The CLA content of l.d. was also higher for HFO than for LFC, but the increase was of higher magnitude for NI (11 vs. 5 mg/g meat) than for I (6 vs. 3 mg/g meat) (interaction, P=0.03). This trial shows several interactions between diet and anabolic implant on carcass quality and FA composition in finished steers.

Key Words: Beef, Implant, CLA

M374 Effects of flunixin meglumine on pyrexia, production, and bioenergetic variables in post-parturient dairy cows. G. Shwartz*[1], S. R. Hartman[1], J. D. Earnest[1], A. L. Debold[1], K. L. Hill[2], M. J. VanBaale[1], and L. H. Baumgard[1], [1]*The University of Arizona*, *Tucson*, [2]*Schering Plough Animal Health*, *Kenilworth, NJ*.

Multiparous cows (n=26) were randomly assigned to one of two treatments beginning at parturition. Treatments were flunixin meglumine (Banamine®, 50 mg/mL, Schering Plough Animal Health, Kenilworth, NJ) at a dose of 2cc/45.5 kg BW and control (saline) at 2cc/45.5 kg BW. All treatments were administrated I.V. via a jugular catheter daily for the first 3 DIM. Individual milk yield (MY) and DMI were recorded daily. Body temperature (BT) was measured daily at 0700 h and 1600 h for the first 7 DIM. Milk composition was determined on 2, 7, 14, 21, 28, and 35 DIM. Blood plasma was harvested on 1, 2, 3, 4, 7, 14, 21, 28, and 35 DIM. BW and BCS were determined on -7, 1, 7, 14, 21, 28, and 35 DIM. BT did not differ between treatments during the first 7 DIM (38.87°C), and there was no treatment differences in overall MY (35.2 kg/d), 3.5% FCM (37.6 kg/d), or ECM (37.7 kg/d). Compared to controls, flunixin meglumine had no effect on DMI (2.97% of BW), or overall energy balance (-2.32 Mcal/d). There were no treatment differences in milk fat (3.91%), milk protein (3.32%), milk lactose (4.57%), and milk SCC (532 × 1000/mL). Treatment had no effect on plasma glucose (66.5 mg/dL) or plasma NEFA (553 μEq/mL), but circulating PUN tended to be lower in flunixin meglumine treated cows (16.4 vs. 14.5 mg/dL). Irrespective of treatment, when separated into a BT hierarchy (warmest 50% vs. coolest 50%; 39.21 vs. 38.64°C) cows with a higher body temperature during the first 7 DIM had an overall lower PUN (13.8 vs. 16.6 mg/dL), higher plasma NEFA (642 vs. 493 μEq/mL), and tended to have a lower energy balance (-4.09 vs. -1.19 Mcal/d). Warmer cows also had increased milk SCC (955 vs. 200 × 1000/mL), but BT had little or no effect on other milk components and production parameters. Daily flunixin meglumine administration for the first 3 d after parturition had little or no effect on production or energetic variables, but tended to decrease PUN levels in transition dairy cows.

Key Words: Flunixin Meglumine, Transition Cow, Pyrexia

Monday, July 9, 2007
SYMPOSIA AND ORAL SESSIONS

ADSA Southern Branch Graduate Student Competition

8 Effects of protein sources on growth and hormonal status of weaned dairy calves. C. A. Sissell*, C. C. Williams, C. F. Hutchison, D. T. Gantt, L. R. Gentry, A. J. Bridges, and J. E. Chandler, *Louisiana State University Agricultural Center*, *Baton Rouge*.

Eight weaned Holstein calves approximately 6 months of age (mean BW 185.15 ± 16.16 kg) were used in a replicated 4 x 4 Latin Square designed experiment to study the effects of protein sources on performance of weaned dairy calves. Dietary treatments consisted of 16% CP diets with three sources of ruminally undegradable protein (RUP). Experimental diets were corn-silage based, with soybean meal (SBM) as the source of ruminally degradable protein (control) and 3 sources of RUP including heat treated SBM (SoyPlus), animal protein blend (ProLak), and extruded-expelled SBM, all included at 45% of the dietary CP. The animals were fed their respective diets twice daily at ad libitum levels during each 14-d adjustment period and 4-d sample collection period. Animals were housed in individual stalls for 14 days for dietary adjustment and feed intake measurements. Steers were housed in metabolism crates during the last 4 days of each experimental period for sample collection. Total fecal and urine output was collected, weighed, and sub sampled for laboratory analysis of nitrogen during the 4-d collection period. On day 4 of the collection period, animals were fitted with jugular catheters. Blood samples were collected at 15-minute intervals for 6 hours for analysis of growth hormone (GH). Also on day 4, blood samples were collected at the beginning of the 6 hours for plasma urea nitrogen (PUN) and at 30-minute intervals for analysis of IGF-I and insulin. On day 18 of each experimental period body weight, wither height, hip height, and body length were measured. Treatment did not affect dry matter intake ($P > 0.05$). There were also no effects ($P > 0.05$) of protein source on nitrogen balance, PUN, or on any growth parameters measured. There was a treatment effect ($P < 0.01$) on GH, with calves fed extruded-expelled SBM having the lowest concentrations. Plasma IGF-I concentrations were greater ($P < 0.05$) in calves consuming extruded-expelled SBM and Prolak. Treatment did not affect ($P > 0.05$) insulin concentrations. These data suggest that feeding diets with sources of RUP does not improve performance in weaned dairy calves.

Key Words: Weaned Calves, Rumen Undegradable Protein, Hormones

9 Impact of feed management software on whole farm nutrient balance and feeding management. B. G. Cox*, R. E. James, K. F. Knowlton, M. L. McGilliard, and C. C. Stallings, *Virginia Polytechnic Institute and State University*, *Blacksburg*.

The impact of precision feeding utilizing feed management software on whole farm nutrient balance (**WFNB**) and feeding management was assessed from January through December 2006. Nine treatment and six control farms were selected in four regions of the Chesapeake Bay Watershed of Virginia. Herd sizes averaged 271 and 390 lactating cows for treatment and control farms while milk yield averaged 30 and 27 kg/d per cow, respectively. Crop hectares grown averaged 309 and 310 ha for treatment and control farms, respectively. Treatment farms purchased and installed feed management software (TMR Tracker™, Digi-Star LLC, Fort Atkinson WI) between May and October 2006. Data were collected for calendar year 2005 and 2006 to compute WFNB using software from the University of Nebraska. On treatment farms, up to five feed samples were obtained monthly including each total mixed ration fed to lactating cows. Control farms submitted total mixed ration samples every 2 mo. Standard wet chemistry analysis of samples was performed. Data stored in the software were collected monthly from each treatment farm concurrent with feed sampling. Daily overfeeding of all ingredients across treatment farms averaged 1.25% ± 5.86, ranging from –67.28% to +54.57%. This corresponded to average daily overfeeding of CP and P of 2.26% ± 6.88 and 1.91% ± 6.39, respectively. Whole farm nutrient balance did not differ between treatment and control farms. In conclusion, WFNB was not reduced after 3 to 6 mo of using feed management software; however, the large variation in daily over or under feeding indicates potential for future reductions through reduced variability.

Key Words: Precision Feeding, Whole Farm Nutrient Balance, Phosphorus

10 Nutrient synchrony: Sound in theory, elusive in practice. M. B. Hall*, *U.S. Dairy Forage Research Center, USDA-ARS*, *Madison, WI.*

The concept of improving animal performance through synchronizing ruminal availability of nutrients has been with us for at least 3 decades. Though theoretically appealing, research and field results have not supported this approach to diet formulation. Why? Essential to successful ruminal synchrony is the ability to predict available amounts and fates of diverse substrates. The substrates come from varied sources; their efficiencies of use and yields of products are affected by inherent properties, interactions, transformations, and passage. Substrate quality and availability is affected only in part by diet: for example, NPN, true protein, and peptides are contributed by diet and intraruminal recycling, with additional endogenous NPN contributions by the cow. Conversion of the ruminally degraded N sources to AA available to the cow depends greatly upon availability of fermentable carbohydrates and other nutrients that support microbial growth. However, changes in factors that alter rate or extent of substrate fermentation such as rate of passage or ruminal pH can alter nutrient yield from the rumen, and must be accounted for for synchrony to work. Yield of microbial protein from carbohydrate can be altered by type of N source available, but these may be available from intraruminal recycling and diet. Conversion of some carbohydrates such as sucrose and fructan to stored microbial α-glucan alters the prediction of carbohydrate available in the rumen. Our ability to estimate ruminally available substrate is also challenged by normal variation in feed composition and imprecision in component and digestibility analyses. To have any effect on performance, ruminal synchronization of nutrients needs to be in concert with specific nutrient demands of the animal. "Synchrony" implies a greater deliberate precision than may be currently possible to effect. Perhaps we should consider balance: Within the rumen and cow, can we generate conditions so that needed substrates or nutrients are concurrently available or accessible from endogenous resources to enhance productivity and efficiency? This approach brings a broader view than focusing on the rumen and feed we offer to the cow.

Key Words: Diet Formulation, Fermentation, Rumen

11 Nitrogen recycling and the nitrogen economy of ruminants – asynchronous symbiosis. C. K. Reynolds*[1] and N. B. Kristensen[2], [1]*The University of Reading*, *England*, [2]*University of Aarhus*, *Denmark*.

The extensive development of the ruminant forestomach sets apart their nitrogen economy from that of nonruminants in a number of respects. Extensive pre-gastric fermentation dramatically alters the profile of protein reaching the small intestine, largely through the transformation of dietary protein and nitrogenous compounds into microbial protein. This process is fueled primarily by carbohydrate fermentation, and includes extensive recycling of nitrogen between the body and gut lumen pools. Nitrogen recycling occurs via blood and gut lumen exchanges of urea and ammonia, as well as endogenous gut and secretory nitrogen entry into the gut lumen, and the subsequent digestion and absorption of microbial and endogenous protein. Factors controlling urea transfer to the gut from blood, including the contributions of urea transporters, remain equivocal. Ammonia produced by microbial degradation of urea and dietary and endogenous amino acids is utilized by microbial fermentation, or reabsorbed and primarily converted to urea. Therefore, microbial growth and carbohydrate fermentation impact on the extent of ammonia absorption and urea recycling and excretion. The extensive recycling of nitrogen to the rumen represents an evolutionary advantage of the ruminant in terms of absorbable protein supply during periods of dietary protein deficiency, or asynchronous carbohydrate and protein supply, but incurs a cost at higher nitrogen intakes, especially in terms of excess nitrogen excretion. Efforts to improve the efficiency of nitrogen utilization in ruminants by synchronizing fermentable energy and nitrogen availability through feedstuff selection, or the manipulation of urea or protein degradation, have generally met with limited success as regards production responses, but may influence nitrogen excretion. The microbial symbiosis of the ruminant is inherently adaptable to asynchronous nitrogen and energy supply. To synchronize, or not to synchronize: that is the question.

Key Words: Ammonia, Rumen Synchrony, Urea

12 Opportunities to enhance performance and efficiency through nutrient synchrony in forage-fed ruminants. M. J. Hersom*, *University of Florida*, *Gainesville*.

Increasingly, the need for optimized nutrient utilization to address increasing costs of production and environmental considerations will necessitate opportunities to improve nutrient synchrony. Historical attempts at synchronizing nutrient supply in ruminants, particularly in cattle consuming high-forage diets, has met with variable results. The success of nutrient synchrony has been measured primarily in ruminants by increases in microbial yield, microbial efficiency, nutrient utilization, and to a lesser extent animal performance. Successful synchrony of nutrient supply to cattle consuming forage-based diets faces several challenges. From a feed supply aspect, the challenges to nutrient synchrony include accurately measuring forage intake and consumed forage chemical composition. The issue of forage intake and chemical composition is perhaps the most daunting for grazing cattle. Indeed, for forage-fed cattle the availability of forage protein and carbohydrate can be the most asynchronous aspect of the diet. In most grazed forages, digestion rates of the carbohydrate fractions are much slower than that of the corresponding protein fractions. Additionally, the forage-supplement interaction exerts a large impact on the synchrony of nutrients. The supplemental feedstuffs comprise the component of the nutrient synchrony scenario that is most often manipulated to influence synchrony. The supplement type (starch vs. fiber, dry vs. liquid), nutrient profile (DIP vs. UIP), and degradation rates are often prime considerations associated with nutrient synchrony on high-forage diets. Other considerations that warrant attention include temporal intake patterns of the forage and supplement, increased use and types of co-product supplements, and an assessment of the success of nutrient synchrony. Synchronization of nutrient utilization by forage-fed ruminants has and will continue to encounter challenges for successful outcomes. Ultimately it is the improvement of animal performance and optimization of nutrient utilization efficiency that dictates whether nutrient synchrony is a successful strategy.

Key Words: Cattle, Diet Synchrony, Forage

13 Opportunities to enhance performance and efficiency through nutrient synchrony in concentrate-fed ruminants. N. A. Cole*, *USDA-ARS-CPRL*, *Bushland, TX*.

Synchronization of the ruminal degradation of carbohydrates and CP is projected to increase ruminal microbial protein synthesis, and improve N use efficiency. Attempts to synchronize the fermentation of dietary carbohydrates and CP have met with mixed results, suggesting that either ruminal nutrient synchrony is not important, or that N recycling to the rumen can offset a lack of synchrony. We hypothesized that in high-concentrate diets N utilization could be improved by synchronizing the supply of nutrients in one segment of the gut with those in another segment (i.e., synchronize a ruminal N deficiency with a lower gut N excess, etc.) via oscillating the dietary CP between deficient and adequate concentrations. With corn-based diets and oil-seed based natural protein supplements, N retention has been greater in lambs or steers fed oscillating CP concentrations (at 48-h intervals) than in animals fed a constant CP percentage. Effects of oscillating CP on cattle performance have been variable, and may depend upon the fermentability of the carbohydrate source (e.g., forage vs. grain, grain processing). In agreement with our hypothesis, Archibeque et al. (2007) reported that net portal uptake of urea was greater in lambs fed oscillating CP than in lambs fed constant CP concentrations. Nutrient intakes also need to be synchronized with the animal's requirements. One method to adjust nutrient intake with requirements is via phase- feeding. Results of studies with dry-rolled corn-based diets indicate that dietary CP concentrations can be decreased late in the feeding period with no adverse effects on animal performance; however, results of studies using steam-flaked corn-based diets are less consistent, possibly due to differences in the aggressiveness of the implant program used. In conclusion, ruminal nutrient synchrony is theoretically a sound principle; however, it seems that N recycling may mitigate effects of asynchrony. Thus, methodologies that increase N recycling and(or) increase the utilization of recycled N may benefit animal performance and the environment.

Key Words: Beef Cattle, Nutrients, Synchrony

Animal Behavior & Well-Being - Livestock and Poultry I

14 Does flavored sow's milk matched with the same flavored post-weaning feed improve performance, reduce post-weaning aggression, and establish an odor preference in piglets? N. Krebs* and J. J. McGlone, *Texas Tech University*, *Lubbock*.

Odor conditioning has been shown in utero and post-partum in rodents. The objective of this study was to determine the effects of post-partum conditioning of piglets to onion given in the sow diet (and through the milk) on behavior and performance of piglets weaned onto onion-flavored feed. Sows (n = 24) and piglets (N = 96) were assigned (N = 12 experimental units/treatment) to treatments: onion (ON), added to the sows′ diet before and after parturition (during lactation), or control diet (CON). Before weaning, the ON and CON piglets were tested in a Y-maze for 1 minute to determine if they were attracted to onion smell. Pigs were .more attracted to the left side than the right side (Preference Index: 55% ± 4.03 vs 38.6 ± 4.28) but there was no effect of the odor treatment ($P > 0.05$). At weaning, ON and CON pigs were kept in treatment groups and given an onion-flavored diet. Aggressive behavior was recorded by 5 min scan samples over 24h after weaning. Performance was recorded for 4 weeks post-weaning. Pigs on the east side (EA) of the room (regardless of the treatment) fought less than the pigs that were on the west side (WE) (3.13 % of the time based on 5 min scan samples over 24h ± 0.84 vs 6.43 % ± 1.10). CON pigs had a greater percentage time engaged in aggressive behaviors ($P < 0.05$) than the ON pigs (5.99 % of the time over 24h ± 0.767 vs 3.64 % ± 0.767). The weight at d 0 (day of weaning) significantly ($P < 0.0001$) affected the weight at d 1, 7, 14, 21, and 28 after weaning. Weight gain and feed efficiency were calculated. Treatments did not influence ($P > 0.10$) pig performance, although the treatment by barn-side interaction ($P < 0.05$) may have masked main effects. Odor conditioning had no effect on ON preference in a Y-maze, or on post-weaning performance, but odor conditioning reduced piglet post-weaning aggressive behavior.

Key Words: Pigs, Conditioning, Behavior

15 Sex differences in the septal-hypothalamo-pituitary-adrenal axis and distribution of arginine vasotocin and cortocotropin releasing neurons in the domestic fowl. F. N. Madison*, A. Jurkevic, and W. J. Kuenzel, *University of Arkansas*, *Fayetteville*.

Stress is a common stimulus faced by birds in the poultry industry and a better insight into a bird's response to a stressor could lead to improvements in productivity and well-being. In domestic fowl, males have been shown to have higher corticosterone (CORT) levels in response to acute stressors and to be more fearful than females. This suggests that males are more responsive to stress. Sexually dimorphic regions of the brain have been found in a few avian species, yet little is known about sex differences in the septo-hypothalamic region of the brain of the chicken, nor in the neuroendocrine release of stress hormones. We studied sex-related responses to intracerebroventricular injections of neuropeptides. Our past studies showed that male birds had significantly lower basal levels of plasma CORT than females, however males injected with arginine vasotocin (AVT) and corticotropin releasing hormone (CRH) had higher plasma CORT release than females (148% and 90% greater increase at peak response, respectively). Immunocytochemical studies were performed on sexually mature male and female chickens to determine the distribution of AVT and CRH anatomical profiles within the septo-hypothalamic region. Sexually dimorphic differences were observed in the medial bed nucleus of stria terminalis (BSTM), lateral septum (SL), and paraventricular nucleus (PVN). Co-localization of AVT and CRH neurons and fibers were present in the BSTM and SL of males, not females. There were more CRH perikarya in the PVN of female birds compared to males. A significant number of CRH fibers formed baskets around AVT neurons in the supraoptic nucleus of both males and females. Our results demonstrate that females have a higher number of CRH neurons in the PVN, higher baseline levels of plasma CORT, but are less responsive to ICV injections of CRH. Supported in part by NSF grant #IBN 01111006 and NRI grant #2005-35203-15850 from USDA, CSREES.

Key Words: Stress Response, Corticosterone, BSTM and PVN

16 Changes in feeding and standing behavior of transition cows predict risk of sole hemorrhages and ulcers. K. L. Proudfoot*[1], D. M. Veira[2], D. M. Weary[1], and M. A. G. von Keyserlingk[1], [1]*University of British Columbia*, *Vancouver, BC, Canada*, [2]*Pacific Agri-Food Research Centre*, *Agassiz, BC, Canada*.

The development of sole hemorrhages and ulcers in dairy cows has been associated with environmental and systemic events related to calving, but the nature of these relationships is unclear. The aim of this study was to identify the relationship between cow behavior around the calving period and the development of lesions later in lactation. The claws of 55 multiparous and 23 primiparous Holstein dairy cows were scored for sole hemorrhage severity and presence of ulcers 2 wk before calving, 3 wk after calving and every 4 wk thereafter until 15 wk. Individual dry matter intake and inactive standing time were recorded from 2 wk before calving to 2 wk after calving. Following data collection, cows were grouped into those with no/low hemorrhage scores throughout the study (healthy), high hemorrhage scores after 3 wk post-calving and ulcers after 3 wk post-calving. Differences in dry matter intake and inactive standing time between the groups and within the periods -2 wk, +2 wk and +24 hr relative to calving were then analyzed using a SAS mixed model where group, parity and body weight were fixed effects and cow was a random effect. Multiparous and primiparous cows were analyzed separately. Multiparous cows that developed ulcers (n=6) ate more in the 2 weeks leading up to calving (17.50±0.72 vs. 15.32±0.43 kg/d P=0.01) and first 24 h after calving (16.88±1.97 vs. 11.93±1.13 kg/d P=0.04) compared to healthy cows. High hemorrhage score cows (n=12) stood longer (not eating) in the 2 wk before calving (653±44 vs. 540±33 mins/d P=0.05) and 24 h after calving (632±43 vs. 801±54 mins/d P=0.02) compared to healthy cows. No differences in feeding or standing behavior were found between healthy and high hemorrhage score first-lactation heifers. These data indicate that changes in feeding and standing behavior of multiparous transition cows are associated with the development of sole hemorrhages and ulcers later in lactation.

Key Words: Lameness, Behavior, Claw Horn Lesion

17 The effect of light intensity on broiler behavior and welfare. R. A. Blatchford*, J. A. Mench, P. S. Wakenell, and G. S. Archer, *University of California*, *Davis*.

Broilers are typically raised commercially in dim lighting. It has been suggested that providing brighter diurnal light intensity could improve bird health and provide opportunities for more normal behavioral rhythms. We examined the effects of three light intensities (5, 50, and 200 lux) on behavior and leg condition of broilers (N = 455, with 4 replicate pens/treatment). Broilers were reared under these intensities from 1-6 wk of age; photoperiods consisted of 16L: 8D with 1 lux intensity during the scotophase for all treatments. General activity was measured continuously using passive infra-red detection, and feeding activity measured by the amount of feed consumed per hour, during one 24-hour period per pen each week. At 6 weeks of age, all broilers were gait scored using a 0-5 scoring system, weighed, euthanized, and evaluated for the occurrence of leg abnormalities. There were no significant differences between treatments for body weight (mean = 2.32±0.01kg; P = 0.58), feed conversion ratio (0.18±0.004; P = 0.77), or feeding activity (0.94±0.04 kg/hr; P = 0.98). There were no significant differences in gait score, but broilers reared with 50 lux had more (P = 0.002) hock erosions (32 broilers) than those reared with either 5 or 200 lux (17, 10). There was also a trend for broilers reared with 5 lux to show less (P = 0.08) general activity during the day than 50 or 200 lux and show less (P = 0.001) change in activity between day and night than 50 or 200 lux. Thus, rearing broilers with dim light (5 lux) appeared to decrease activity, while intermediate light intensity (50 lux) was associated with poorer leg health but not increased lameness.

Key Words: Broiler, Lighting, Welfare

18 Separating the effects of group size, stocking density and pen size in broilers. E. H. Leone* and I. Estevez, *University of Maryland*, *College Park*.

In examining stocking density (SD), group size (GS), or pen size (PS) there is inadvertent confounding between two or more variables. While traditionally a three factor analysis is required to separate the confounded effects our design maximized replication use, reducing the number of treatments required. We used GS of 10, 20, and 30 birds in 1.5m^2, 3.0m^2 and 4.5m^2 PS to study broiler movement and space use. GS 10 was placed in all PS, GS 20 in 3.0m^2 and GS 30 in 4.5m^2 PS. This enabled us to look at increasing PS at constant GS (10) and SD (0.15 m^2/ bird) and across constant PS where GS/SD increased (GS 10 vs. 20 in 3.0m^2 and GS 10 vs. 30 in 4.5m^2 PS). Five focal birds were randomly chosen in each pen and their locations recorded via scan sampling. While the total area utilized by the birds increased with PS both for constant GS and SD ($p<0.05$), the percentage of space utilized decreased ($p<0.05$). When SD remained constant broilers were more active in larger PS ($p<0.05$) and birds in similar PS were more active at higher GS/SD ($p<0.05$). Interactions with a greater number of group members may have a more profound effect on activity levels than PS alone. At a constant PS movement patterns became more complex for larger GS/SD ($p<0.05$). While nearest neighbor distances increased with PS ($p<0.05$), differences were more pronounced across constant GS than SD. Although net displacement, defined as the distance between the first and last observed location, lengthened with growing PS at constant GS ($p<0.05$), SD was most likely the contributing factor. In equal PS displacement and total distance traveled dropped at higher GS/SD ($p<0.05$). Overall PS, SD, and GS had significant and individual influences on movement patters in broilers. PS had the strongest effect on the average distance traveled, whereas SD and GS heavily impacted activity levels, complexity of movement, net displacement, and total distance traveled.

Key Words: Movement, Use of Space, Broiler

19 Reducing stress at the packing plant using prior training and conditioning to odors in finishing pigs. N. Krebs*, M. A. Sutherland, and J. J. McGlone, *Texas Tech University*, *Lubbock*.

Finishing pigs are infrequently handled on some farms and can be difficult to handle when experiencing novel situations. This study aimed to determine the effects of minimal training and conditioning of finishing pigs to a novel odor (maple syrup, MS) on the ease of handling in a novel environment (simulated processing plant pre-stun area). Pigs were assigned one of four treatments organized with a 2 × 2 factorial arrangement: training and odor exposure at the barn for 10 d (trained-TR or not trained-NOTR) and odor at the plant or not (MS or NO). Trained (TR) pigs (n = 140) were allowed out of their home pens and could chew on MS-soaked flags. NOTR pigs (n = 140) were

not handled nor exposed to MS. The day of the experiment, TR and NOTR pigs were loaded, transported, unloaded, rested, then they experienced a novel simulated pre-stun area. For the MS-pigs, MS was put in the simulated CO2 stun box. The NO-pigs were not exposed to MS. Trained pigs (TR) unloaded faster ($P < 0.05$) than NOTR pigs (TR: 5.61 s/pig ± 1.79; NOTR: 13.8 s/pig ± 1.79). Trained (TR/MS and TR/NO) and NOTR/MS pigs received more ($P < 0.05$) paddle hits in the first part of the pre-stun than the NOTR/NO pigs (TR/MS: 0.010 hits/pig/s ± 0.0015; TR/NO: 0.012 hits/pig/s ± 0.0015; NOTR/MS: 0.015 hits/pig/s ±0.0015; NOTR/NO: 0.00 hits/pig/s ±0.0015) but MS pigs received less ($P < 0.05$) hits in the second part of the pre-stun compared to NO pigs (0.039 hits/s/pig ± 0.0051 vs 0.074 ± 0.0051). TR pigs spent less ($P < 0.05$) time backing up than NOTR pigs (0.082 % ± 0.68 vs 2.43 % ± 0.68 of the time). TR pigs had lower ($P < 0.05$) neutrophils (TR: 41.1 % ± 1.4; NOTR: 47.6 % ± 1.4) and lower ($P < 0.05$) neutrophil:lymphocyte ratio (TR: 0.89 ±0.05; NOTR: 1.13 ±0.05) than NOTR pigs. Cortisol levels increased ($P < 0.01$) with the total time spent in the chute. Adapting facilities and routine management to allow pigs free time outside the finishing home pen with a unique taste and/or odor that is also present at the processing plant may improve the welfare of pigs, the ease of handling, and the time required to move pigs at harvest.

Key Words: Pigs, Stress, Conditioning

20 The efficacy of Meloxicam at relieving the pain response to dehorning in dairy calves. A. Heinrich*[1,3], T. Duffield[1,3], K. Lissemore[2,3], E. J. Squires[1,3], and S. T. Millman[1,3], [1]*Ontario Veterinary College*, *Guelph, ON, Canada*, [2]*Ontario Agricultural College*, *Guelph, ON, Canada*, [3]*University of Guelph*, *Guelph, ON, Canada*.

The objectives of this study were (1) to describe the duration of pain when calves were dehorned using a local anesthetic and (2) to determine if Meloxicam (Metacam®, Boehringer Ingelheim, Germany) is effective at mitigating the pain response to the procedure. Meloxicam is a preferential COX-2 inhibiting NSAID with a half-life of approximately 26 hours in bovines. In this study 60 Holstein heifer calves, age 6 to12 weeks, were blocked by age and randomly assigned to Meloxicam and control treatments. Ten minutes prior to dehorning, calves received a lidocaine cornual nerve block and an I.M injection of either Meloxicam (0.5 mg/kg) or saline. Calves were dehorned using heat cauterization. Twenty-four hours prior to dehorning calves were sham dehorned using the unheated dehorner. Blood samples were taken via indwelling jugular catheters 0, 0.5, 1, 1.5, 2, 4, 6 and 24 hours following sham and actual dehorning in order to measure serum cortisol. Cortisol was measured using human radioimmunoassay kits validated for use with bovine blood (Coat-a-Count®, DPC, Markham, ON). Pain sensitivity was measured 4 hours after treatment using an algometer. Digital videorecording was used to collect behavior data for 24 hours following sham and 48 hours following dehorning. Data was analyzed using the Mixed procedure in SAS (version 9.1.3; SAS Institute Inc., Cary, NC, USA) with responses during the sham procedures used covariates. Meloxicam treated calves displayed significantly less pain sensitivity than Controls ($p=0.012$). Meloxicam treated calves also had significantly lower serum cortisol than Controls at all time periods except at 24 hours after dehorning ($p<0.05$). Preliminary behavior results suggest that Meloxicam treated calves performed less ear flicking and head shaking for at least 28 hours following dehorning. There was also a visible circadian pattern to behavior, with calves demonstrating the majority of pain-related behaviors in the late afternoon. In conclusion, dehorning causes long-term pain and the prolonged action of Meloxicam is effective in alleviating the chronic pain associated with dehorning.

Key Words: Dehorning, Pain, Behavior

21 Removal of sub-therapeutic antibiotics from nursery pigs diets: influence on behavior, performance and physiology. C. Goldsmith*, L. Sadler, K. Stalder, L. Karriker, M. Honeyman, and A. Johnson, *Iowa State University*, *Ames*.

Sub therapeutic use of feed grade antibiotics for food animals is being debated. The objective of this study was to determine the effects on nursery pig behavior, physiology and performance of removing sub-therapeutic antibiotics from nursery feeds. Nursery pigs (224 crossbred; 17 - 20 d of age) were assigned to pens (4 pigs/pen) in a completely randomized design arrangement of dietary treatments (with and without feed grade antibiotics). Sub-therapeutic antibiotics used were carbadox and tiamulin/CTC at approved levels. The treatment without antibiotics had additional dietary fat (choice white grease) added at a level of 50%. All pigs were housed in pens (0.36 m^2/pig; 2 gilts/2 barrows per pen) with slatted plastic flooring. Pigs were provided ad lib access to feed and water during three dietary phases from 6 to 23 kg BW. Proc Mixed of SAS was used to implement a fixed and random effects model. When dietary phases changed, the time required for all pigs in a pen to initially visit the feeder was recorded. Pigs fed diets without antibiotics visited the feeder more quickly ($P = 0.004$) than pigs fed diets with antibiotics (575 ± 210 vs. 1454 ± 210 s). Respiration rates and rectal temperatures were taken weekly on one barrow and gilt per pen and there were no treatment differences ($P > 0.05$). Pigs fed diets containing no antibiotics had better ($P < 0.01$) ADG (0.44 vs. 0.37 ± 0.01 kg/d) and had improved ($P = 0.015$) Feed to Gain than pigs fed diets containing antibiotics (1.48 vs. 1.66 ± 0.04 kg/d), respectively. There were no differences ($P < 0.05$) in total nursery feed intake for either dietary treatment. In conclusion, adding 50% more fat to nursery pig diets may allow removal of sub-therapeutic antibiotics when fed to pigs whose health status is not compromised without adversely affecting behavior, physiology or performance.

Key Words: Antibiotics, Behavior, Pigs

22 Effects of ractopamine on transport losses in market weight pigs. J. E. Swan, M. H. Gillis, K. D. Miller, J. D. Muegge, D. H. Mowrey, T. A. Armstrong, W. C. Weldon, and M. J. Ritter*, *Elanco Animal Health*, *Greenfield, IN*.

Data on 192 trailer loads of market weight pigs were collected from two different regions (Midwest and Southeast) over one year under U.S. commercial conditions to determine the effects of feeding ractopamine for 21 to 35 d prior to slaughter on transport losses (dead and non-ambulatory pigs). A randomized complete block design was utilized with farm as the blocking factor. Within each region, effects of ractopamine were evaluated on 96 trailer loads of pigs from four different farms with each farm marketing pigs from four different sites to a common slaughter plant. Within a site, ractopamine treatments (0, 5 or 10 ppm) were randomly assigned to the experimental units, barns, and two trailer loads of pigs were used to evaluate the effect per barn. Pigs were loaded and unloaded according to standard commercial

procedures. The number of dead, non-ambulatory, injured (NAI), and non-ambulatory, non-injured (NANI) pigs were recorded during loading, unloading, and the final drive. Data were analyzed using a generalized mixed effects model (GLIMM, SAS® macro GLMM800). Effects of ractopamine on total losses (dead + NAI + NANI) were dependent upon region. Ractopamine had no impact on total losses (1.35% vs. 0.85% vs. 1.55%, respectively for 0, 5, and 10 ppm) in the Southeast. However, in the Midwest, pigs fed ractopamine had higher total losses than control pigs (1.33% vs. 2.63% vs. 2.26%, respectively for 0, 5, and 10 ppm). It is possible that differences in transport times and conditions across the two regions may have contributed to these conflicting results. On average, pigs in the Midwest had 61 min longer journeys, 24 min longer waiting times prior to unloading, 33 min longer unloading times, and 194 min shorter lairage times than pigs in the Southeast. Also, electric prods were used on 52% and 97% of the loads during unloading and during the final drive in the Midwest, while electric prods were not used at these stages in the Southeast. These data suggest that the effects of ractopamine on transport losses are dependent upon other factors such as transport times and conditions.

Key Words: Pig, Ractopamine, Transport losses

23 Value of anesthesia in the dehorning of dairy calves. K. N. Patel*, A. L. Magliaro, J. R. Werner, D. A. Pape-Zambito, and R. S. Kensinger, *The Pennsylvania State University*, *University Park*.

Dehorning calves is a common management practice in the dairy industry. Both producers and the public would like dehorning to have as little impact on calf growth and health as possible. Studies have suggested using anesthetics with dehorning to improve calf performance; but there is little objective data on which to base these recommendations for this age group. The purpose of this study was to determine if the use of xylazine and lidocaine in dehorning would affect growth rate, calf health and haptoglobin concentrations. Ninety Holstein heifer calves (6-8 wk old, 64.85 ± 8.1 kg BW) were blocked by age and randomly assigned to: sedative and anesthesia (SA) or control (C) treatment groups. SA calves received 0.2 mg/kg of xylazine IM and cornual nerve blocks with 3 mL of 2 % lidocaine in each cornual cleft. C calves received no drugs. Calves were dehorned by a veterinarian with an electrical iron at 600 C with a mean contact time of 35 s per horn bud. Calves were fed farm-pasteurized milk twice daily and were given calf starter ad libitum. BW was determined using a digital scale equipped with an averaging function (Arlyn 320-LLA). Fecal scores were recorded on days 0, 1, 3, 7, 14, and jugular blood samples were collected on days 0, 1, 3 and 7 relative to dehorning. Calves were observed on each experimental day and a fecal score between 1 (normal) to 4 (watery) was assigned for each calf. Data were analyzed using PROC MIXED in SAS. Health of calves during the study was generally good with 0% mortality, normal respiratory function and average fecal score of 2. Average daily gain from d 0 to d 14 of the study averaged 1.0 kg/d for both SA and C calves and was not affected by treatment. Hematocrit averaged 28 %; and plasma protein averaged 4.7 g/dL for all calves, and neither was affected by treatment. Use of sedative and anesthesia prior to dehorning in the current study provided no detectable change in growth of the calves.

Key Words: Dehorning, Anesthesia, Performance

Animal Health - Livestock and Poultry: Poultry and Swine I

24 Over-supplementation of Vitamin D as a risk factor for chronic heart failure in fast growing commercial broilers. S. Nain*, B. Laarveld, and A. A. Olkowski, *University of Saskatchewan*, *Saskatoon, SK, Canada*.

Broiler diets are frequently fortified with Vitamin D (D3) above the recommended levels to prevent commonly occurring leg problems. Over-supplementation with D3 has been shown to have detrimental effects on the heart. In order to evaluate the risk of D3 over-supplementation on the incidence of chronic heart failure in fast growing broilers, we examined the effects of high dietary D3 in commercial male broilers. 364 Ross male chicks were randomly assigned to six pens and offered a commercial broiler diet (vitamin D 5,000 IU/kg) or a vitamin D enriched diet (80,000 IU/kg). The birds were housed in floor pens in an environmentally controlled room. During the first 7 days the temperature was maintained at 34°C followed by a gradual decrease to a level approximately 30% lower than that set for normo-thermal brooding. Feed and water were provided ad-lib. All birds were monitored several times daily for overt signs of disease and periodically electrocardiographic measurements were obtained. Morbidity and mortality data were collected daily. Electrocardiographic examination revealed a numerically larger number of birds with cardiac arrhythmia and negative QRS axis on lead-II (an indication of left heart failure) in the D3 fed group in comparison to the control group. The blood gas analysis revealed marked hypoxemia, hypercapnia and lower Hb O2 saturation percentage, with the incidence of cyanosis being 33.0% in the D3 fed group vs control group 24.8% ($P<0.05$). The risk of ascites was 3.33 fold higher ($P<0.05$) in birds fed the D3 enriched diet, with the incidence of ascites being 3.3 % in the control and 11.0 % in D3 group. The present findings indicate that over-supplementation of vitamin D increases the risk of chronic heart failure in broilers.

Key Words: Broilers, Heart Failure, Vitamin D

25 Evaluation of Vitamin U on *Salmonella typhimurium* in broilers. A. L. Shaw*, K. S. Macklin, and J. P. Blake, *Auburn University*, *Auburn, AL*.

Vitamin U (DL-methionine methylsulfonium chloride) is a sulfur-containing methionine derivative previously shown to modulate the immune system and protect intestinal membrane cells in humans and swine. Two 28-day trials were conducted to evaluate the effect of Vitamin U on controlling *Salmonella typhimurium* in broilers. Each trial utilized day-old straight-run broilers that were randomly allotted to one of four dietary treatments (3 reps/trt) employing a corn-soy basal diet (21.5% CP, 3142 kcal/kg). Cecal samples were collected from 12 birds and cultured to ensure they were negative for salmonellosis. On day 1, all birds were challenged with 1 ml of *Salmonella typhimurium* (10^8 cfu/ml) via oral gavage. Cecal samples (3 birds/trt in Trial 1;

6 birds/trt in Trial 2) were collected weekly to derive colonization counts. Liver samples were also collected and enriched to determine if birds were septic. In Trial 1, treatments consisted of the basal diet containing no feed additive (control), Bio-Mos (900 mg/kg), low Vitamin U (300 mg/kg), or high Vitamin U (600 mg/kg). Significant differences in salmonella colonization increased among all treatments compared with the control during week 2. Treatments for Trial 2 were comprised of the basal diet containing no feed additive (control), Bio-Mos (900 mg/kg), BMD (50 mg/kg), or Vitamin U (300 mg/kg). Intestinal tissue samples were collected and measured from four birds per treatment on day 14. Results indicated that Salmonella colonization during week 1 was lower ($P<0.05$) for Bio-Mos than Vitamin U, and during week 3 Vitamin U was lower ($P<0.05$) than BMD. The villi length of the jejunum and ileum, and crypt depth of the duodenum and ileum were significantly longer ($P<0.05$) in the control in comparison to the three treatments tested. It was concluded that the overall effects of Vitamin U on salmonella colonization and septicemia are comparable to Bio-Mos. Vitamin U was not found to have an effect on intestinal tract integrity.

Key Words: Vitamin U, Bio-Mos, *Salmonella typhimurium*

26 Arginine and vitamin E modulate the subpopulations of T-lymphocytes in broiler chickens. S. T. Abdukalykova* and C. A. Ruiz-Feria, *McGill University*, *Montreal, QC, Canada*.

We examined the effects of vitamin E (VE) and ARG (ARG) on the subpopulations of T lymphocytes in peripheral blood after an IBDV vaccination. Broiler chickens were fed diets with normal levels of ARG (NARG) or high levels of ARG (HARG, 1% added to the feed); and three levels of VE (40, 80, or 200 IU / kg of feed) in a factorial arrangement of treatments. Fifty four broiler chickens were vaccinated at 20d of age. The percentages of T-helper (Th) and T-cytotoxic (Tc) cells 9d after vaccination were not different in birds fed the HARG or NARG feed, but they were higher in birds fed the VE80 diet than in birds fed the VE40 diet. Birds fed the VE200 feed had similar levels of Th and Tc cells than birds fed the VE40 diet ($P=0.02$). However, 19 after vaccination, the percentage of Th cells were higher in birds fed the HARG (43.93±1.05;$P=0.045$) diet than in birds fed the NARG diet (41.14±1.05; $P=0.045$), and in birds fed the VE80(44.1±1.28; $P =0.003$) diet as opposed to the VE40 (39.04±1.28; $P =0.003$), yet similar to that of VE200 (44.42±1.28; $P =0.003$) diet. The percentage of Tc cells was highest in birds fed the HARG and VE80 feed compared with all the other ARG and VE combinations. The B-cell:T-cell ratio was higher in birds fed the HARG (0.27±0.009; $P=0.01$) diet than in birds fed the NARG diets (0.24±0.009; $P=0.01$) and birds fed the VE40(0.32±0.01; $P <0.001$) than in birds fed VE80(0.22±0.01; $P<0.001$) and VE200 (0.23 ±0.01;$P <0.001$) diet 9 d after vaccination. Neither ARG nor VE had an effect on the Th:Th cell ratio, and on the percentage of immature (CD4+CD8+) T-lymphocytes. These results suggest that ARG and VE have synergistic effects on cellular immune function and may enhance the resistance of broilers to infectious diseases.

Key Words: Arginine, Vitamin E, Cell-mediated Immunity

27 Effects of arginine and vitamin E on antibody production against sheep red blood cells and immune bursal disease virus. S. T. Abdukalykova* and C. A. Ruiz-Feria, *McGill University*, *Montreal, QC, Canada*.

The objective of this study was to evaluate the combined effects of arginine (ARG) and vitamin E (VE) on antibody response to sheep red blood cell (SRBC, agglutination assay) inoculation, and antibody titers (ELISA) to the infectious bursal disease virus (IBDV) before and after vaccination. Broiler chickens were fed diets with normal levels of ARG (NARG) or high levels of ARG (HARG, 1% added to the feed); and three levels of VE (40, 80, or 200 IU / kg of feed) in a factorial arrangement of treatments. The antibody titers to SRBC were higher in birds fed the HARG diet than in birds fed the NARG ($P < 0.013$), and in birds fed the VE80 diet compared with birds fed the VE200 ($P<0.001$) diets at 5, 8, and 12 d after inoculation. Antibody titers (log_{10}) to the IBDV 2d before and 19d after vaccination were higher in birds fed the HARG diet compared with birds fed the NARG diet ($P < 0.001$), whereas birds fed the VE80 diet showed a higher antibody titers compared with birds fed the VE40 diet ($P<0.001$), but similar to those of the VE200 birds. However, the antibody titers against IBDV 5d after vaccination were higher in birds fed the NARG (963.3±8.9; $P<0.001$) diet than in birds fed the HARG (857.1±8.9; $P<0.001$), and in birds fed the VE40 (953.7±10.1; $P<0.001$) diet as opposed to the VE80 (841.1±10.1; $P<0.001$), yet similar to that of VE200 (935.8±10.1; $P<0.001$) diets. In summary, birds fed HARG and VE80 diets showed the best response against SRBC and IBDV vaccination, which may enhance the resistance of broilers to infectious diseases in the field.

Key Words: Arginine, Vitamin E, IBDV

28 Effect of tribasic copper chloride on performance of broiler chickens facing health challenges. J. I. Cohen*, *Micronutrients*, *Indianapolis, IN*.

Two experiments were conducted to evaluate the role of tribasic copper chloride (TBCC) in mitigating the detrimental effects of health challenges. In Experiment 1, 96 1-day-old Ross broiler chicks were divided into the four groups (three replicates each of 8 broiler chicks); Control (basal diet), AF (1 ppm), TBCC (200 ppm copper as TBCC) and AF plus TBCC (1 ppm aflatoxin plus 200 ppm copper as TBCC). The chicks were maintained on these treatments for 42 days. Serum biochemical analyses were performed at the end of the experiment and growth performance parameters of chicks were evaluated weekly during the experiment. The AF-induced changes in the levels of albumin, total protein and total cholesterol, and in the activities of serum ALT, LDH and ALP were detrimentally altered by AF, and significantly improved by adding TBCC to the AF-containing diet. While supplementation of TBCC to the AF containing diet did not improve the BWG, adverse effects of AFs on FCR were reversed by TBCC supplementation. Experiment 2 was a 21-day floor pen study conducted with 300 Cobb chicks divided into five groups (five replicates each of 10 chicks) inoculated with Candida albicans and Coccidia to induce crop mycosis at 3 days of age and fed a corn-soybean meal diet supplemented with 0, 125 or 250 ppm Cu from either feed-grade Cu sulfate or TBCC. As measured by disease scores for spread of infection in crop membranes and for number of observed intestinal lesions, both copper sources at both treatment levels gave a significant improvement over untreated, infected birds, with 250 ppm Cu being statistically better than 125 ppm. Only TBCC at 250 ppm gave crop mycosis scores equal to the negative control. Body weight gain and feed conversion were significantly improved versus the positive control at both 125 and 250 ppm added Cu, regardless of

source. A linear regression of the data showed TBCC to be 112% as bioavailable as copper sulfate. Both studies suggest that TBCC is effective in preventing performance reduction often associated with toxins which challenge broiler health.

Key Words: Tribasic Copper Chloride, Performance, Toxins

29 Detection of bacteria in the vas deferens and testes of broiler breeder roosters. C. R. James*, L. M. Stevenson, S. S. Oates, S. Martin, K. S. Macklin, R. A. Norton, and W. D. Berry, *Auburn University Poultry Science*, *Auburn, AL*.

There have been relatively few studies characterizing the microflora of the rooster reproductive tract with respect to effects on fertility. The ultimate objective of this study is to determine whether fertility of the broiler breeder rooster is affected by reproductive tract microorganisms. Four broiler breeder roosterswer e euthanized by CO2 inhalation. The left vas deferens of each rooster was ligated at its attachment to the cloaca. The vas deferens and the left testis of each rooster was then excised en bloc, rinsed in 70% alcohol, followed sterile .85% saline and placed in a vial of ice cold sterile saline until used for culture. Samples of the vas and testes were minced in phosphate buffered saline. The samples were plated out onto MacConkey agar, blood agar, and plate count agar, and cultured at 37C in an aerobic incubator to detect the presence of aerophilic bacteria; chocolate agar cultured at 37 C in a C02 incubator to detect the presence of microaerophilic bacteria; blood agar, and prereduced blood agar cultured at 37C in an anaerobic chamber to detect the presence of anaerobic bacteria; and potato dextrose cultured at room temperature and atmosphere to determine if fungi were present. These plates were incubated for 24 hours and counted. In both trials a second set of the samples underwent enrichment in BPW prior to culture as above to ensure that any bacteria present would grow. Bacterial colonies grown in this trial were collected and streaked for isolation. They were then fixed onto slides, Gram stained and examined. Aerophilic bacteria, anaerobic, and microaerophilic bacteria were identified, with the majority of the bacteria identified as Gram positive cocci. No fungi were evident. This experiment demonstrates that a complex bacterial community consisting of aerophilic, anaerobic, and microaerophilic bacteria exists in the rooster reproductive tract. Further studies are underway to identify individual bacterial species and their potential effects on reproduction. This work was supported by the Alabama Agricultural Experiment Station and the U.S. Poultry and Egg Association.

Key Words: Reproductive Tract, Bacteria, Broiler Breeder

30 Acquisition of immunity to *Eimeria maxima* in newly hatched chickens reared on new or reused litter. S. Rayavarapu* and H. D. Chapman, *University of Arkansas*, *Fayetteville*.

The acquisition of immunity by chickens infected 18 hours post-hatch with 100 oocysts of *E. maxima* and reared in floor-pens in contact with their droppings was investigated. In the first experiment birds were placed on new litter and immunity was measured at 2, 3, 4, and 5 weeks of age. Immunity had developed in birds challenged at 3, 4, and 5 weeks, judged by weight gain and oocyst production, but at 2 weeks immunity was not complete. In the second experiment birds were placed on new litter or reused litter from the first experiment and challenged at 1, 2, and 3 weeks of age. Immunity had developed in birds challenged at 1, 2, and 3 weeks measured by either criterion. In both experiments birds produced small numbers of oocysts in their feces following challenge. Judged by weight gain following challenge, no significant difference in the acquisition of immunity was observed whether birds were reared on new or reused litter.

Key Words: Eimeria, Immunity, Litter

31 Evaluation of Coccivac-B® and Bio-Cox® (salinomycin) for control of 3 species of *Eimeria* in broilers. C. Brown*[1], R. G. Teeter[1], A. Beker[1], M. Singh[1], C. Broussard[2], S. Fitz-Coy[2], and J. Radu[2], [1]*Oklahoma State University*, *Stillwater*, [2]*Schering-Plough Animal Health*, *Union, NJ*.

An experiment was conducted utilizing Cobb x Cobb males to evaluate coccidiosis control in 6 treatments: control-nonchallenged (CNC); control-challenged (CC); Bio-Cox®-nonchallenged (60g/ton; 0-35 days; SNC); Bio-Cox®-challenged (SC); vaccinated-nonchallenged (Coccivac-B® at hatch; VNC); and vaccinated-challenged (VC). Challenge consisted of an oral dose of sterile saline or a mixture of 3 *Eimeria* species administered as oocysts at 14, 21, 28, 35, and 42 days. Variables examined six days post challenge included live weight, FE, gross lesion scores (upper small intestine: USI; mid small intestine: MSI; ceca: C), and microscopic lesion scores (*E. maxima; E. tenella; and E. acervulina*). CNC birds exhibited higher live weight than CC birds at all ages ($P<0.01$) while results for other treatments are age dependent; VNC birds were similar to VC birds except on 20 and 41 days where VNC exceeded VC ($P=0.05$); SNC birds were similar to SC birds to 35d ($P>0.10$) but exceeded SC live weight thereafter ($P<0.05$). Live weights for CNC, VNC, and SNC birds post challenge were similar for all ages with the exception that SNC birds were depressed on day 48 ($P<0.05$). VC and SC birds were superior to CC birds ($P<0.05$) post 20d. The VC bird weights were similar to SC bird weights to 35d ($P>0.10$), superior post 35d ($P<0.05$) and markedly superior ($P<0.01$) for challenge period live weight gain. Feed efficiency (FE) of challenged birds favored SC only on day 34, while VC birds exhibited a marked superiority post 34d. Indeed, FE following oocyst challenge at 42d was -0.04 for SC and 0.41 for VC on day 48. Lesion scores (0=none; 4=high) for CNC, VNC, and SNC birds did not differ from zero ($P>0.10$) throughout the testing period, while other scores were inversely correlated ($P<0.01$) with live weight, weight gain, and FE. Results demonstrate the importance of time dependency on coccidiosis control.

Key Words: Eimeria, Vaccination

32 Benefits of the broiler feed additive Roxarsone. G. Mathis*[1] and M. LaVorgna[2], [1]*Southern Poultry Research, Inc.*, *Athens, GA*, [2]*Alpharma Animal Health*, *Fort Lee, NJ*.

As early as 1946, it was demonstrated that the feed additive 3-nitro-4 hydroyphenlarsonic acid (Roxarsone) (ROX) improved growth rate and feed conversion and had some anticoccidial activity. Over the years studies were performed examining these findings. A coccidial battery study showed that ROX was particularly effective against E. tenella. The NMI coccidial lesion score was 3.2 and ROX 45. 4 g/t was 1.3. An Anticoccidial drug sensitivity test demonstrated that the addition of ROX to ionophore anticoccidial drugs improves total anticoccidial control. Lesion scores for NMI 2.3, salinomycin 60 g/t

1.7 and salinomycin 60 g/t plus ROX 45.4 g/t 0.4. An improvement in performance of coccidial vaccinated broiler chickens was demonstrated in a 42 day floor pen study. Weight gain for nonmedicated birds was 1.873 kg compared to 1.992 for ROX 34.5 g/t vaccinated birds. In a salmonella challenge study, pens had less salmonella when ROX was fed compared to NM. As the early research indicated, 3-Nitro is beneficial for broiler production especially due to it's anticoccidial activity.

Key Words: Roxarsone, 3-Nitro, Anticoccidial

33 A comparison of performance of coccidia vaccinated broilers fed RepaXol, AciXol, or Bacitracin Methylene Disalicylate. G. Mathis*[1] and N. Scicutella[2], [1]*Southern Poultry Research, Inc.*, *Athens, GA*, [2]*SODA Feed Ingredients*, *Monaco*.

The objective of the two studies was to determine the influence of RepaXol, a blend of double coated essential oils, AciXol, an encapsulated blend of organic and inorganic acids along with RepaXol or Bacitracin Methylene Disalicylate (BMD), an antibiotic, on the performance of coccidial vaccinated broiler chickens reared to 42 days of age. Both studies had a similar experimental design. The second study used built up litter with a higher level of coccidial oocysts and Clostridium. The stocking density was 0.77 sq. ft. per male bird. All chicks were spray vaccinated with a commercial coccidial vaccine. A randomized block design with 8 replications was used. The test treatments were nonmedicated, RepaXol 50 ppm (study 1) and 100 ppm, AciXol 500 ppm (study 1), or BMD 55 ppm. Results showed a significant improvement in Day 42 performance, both feed conversion and weight gain with RepaXol 50 and 100 ppm, AciXol 500 ppm, and BMD 55 ppm compared to the nonmedicated controls. The feed conversion and weight gain for RepaXol and BMD were not significantly different in either study. No matter the background challenge level, RepaXol, AciXol, and BMD improved performance of coccidial vaccinated broiler chickens.

Key Words: RepaXol, AciXol, BMD

34 Identification of *Eimeria* species using Denaturing Gradient Gel Electrophoresis. A. Martynova-Van Kley[1], A. Syvyk*[1], A. Nalian[1], I. Teplova[1], and M. Hume[2], [1]*Steven F. Austin State University*, *Nacogdoches, TX*, [2]*USDA, ARS, SPARC, Food and Feed Safety Research Unit*, *College Station, TX*.

The avian protozoan disease known as coccidiosis causes economic losses to the poultry industry worldwide and costs the U.S. economy an estimated $700 million per year. The causative agent of coccidiosis in the domestic fowl is the protozoan *Eimeria*. Although it is not usually life threatening, coccidiosis has a significant negative impact on growth and feed utilization in chickens. Chickens are known to be infected with at least eight species of *Eimeria*. Application of appropriate preventive and treatment measures depends upon correct identification of the *Eimeria*species affecting a flock. The goal of this project was to identify an appropriate genetic marker and to develop a rapid, accurate, and highly discriminating assay for *Eimeria* species in chicken fecal samples. A multiple sequence alignment of full-length 18S rDNA sequences from seven *Eimeria* species conserved regions were compared for primer design. The theoretical melting profiles of the sequences were overlaid on the alignment to identify a single melting domain which provides the best temperature differentiation. DNA from a live oocyte vaccine (Advent, Viridus, Inc.) was used to create a Novel Ladder-Marker. PCR-DGGE analysis was performed on ~200 fecal samples collected from vaccinated birds, experimentally infected birds, and control birds. The results showed that the proposed approach based on PCR/DGGE analysis can be used for *Eimeria* species detection and identification. The designed primers were shown to be specific for amplification of *Eimeria* species from fecal DNA extracts as well as directly from oocysts. This PCR-based technique offers a rapid and highly discriminating assay for *Eimeria* species identification and with the potential for fast-response strategic intervention targeting coccidia at distinct locations along the digestive tract.

Key Words: Coccidiosis, Eimeria Identification, DGGE

35 Eimeria acervulina and E. mivati: Are they one and the same? S. Fitz-Coy*, *Schering-Plough AH*, *Summit, NJ*.

An experiment was conducted using Cobb x Cobb broiler chickens in cages. At 2 days of age, one group was inoculated with E. acervulina, a second group was given E. mivati and the third group kept coccidian-free, given robenidine in the feed at 33ppm for two weeks. Chickens were inoculated with E. acervulina or E. mivati three times per week, for three weeks. At 28 days of age, birds were randomized into challenge cages. Each bird received 500,000 sporulated oocysts of either E. mivati or E. acervulina by gavage. Trial terminated on day 6 post challenged; weight, gross lesions and microscopic parasite burden evaluated. Birds immunized with E. acervulina or E. mivati, challenged with homologous species grew at comparable rates, 420g and 389g, respectively ($P>0.05$). Birds immunized with E. mivati or E. acervulina and challenged with heterologous species grew at comparable rates, 313g and 264g, respectively ($P>0.05$). Control birds challenged with E. acervulina or E. mivati gained 278g and 91g, respectively; less ($P<0.05$) than birds immunized and challenged with homologous species. Gross lesions for controls-challenged with E. acervulina or E. mivati were highest among the groups (<0.05). Birds immunized with E. acervulina or E. mivati and challenged with homologous species had good protection. But E. acervulina or E. mivati immunized birds and challenged with heterologous species demonstrated no protection, 2.42 and 1.42, respectively. Microscopic parasite load for controls-challenged with E. mvati and E. acervulina immunized E. mivat-challenged birds had the highest scores, 10.73 and 10.5, respectively, ($P<0.05$). Birds immunized with E. acervulina or E. mivati and challenged with homologous species had good protection. Birds immunized with E. mivati or controls-challenged with E. acervulina had similar levels of parasitism, 5.5 and 6.33, respectively ($P>0.05$). Control birds challenged with E. mivati has 18% mortality. E. mivati was more pathogenic than E. acervulina, caused greater growth suppression, higher gross lesions and microscopic parasitism and caused mortality.

Key Words: Eimeria, Acervulina, Mivati

Bio Ethics - Livestock and Poultry: The Ethics of Food Animal Production, Processing and Marketing

36 Introduction. R. D. Reynnells*, *USDA/CSREES/PAS*, *Washington, DC*.

Food animal production systems that supply food and fiber to society have been directly affected by societal demands from the beginning of history. This is true whether most people were directly engaged in food production, or for our current approximately 2 percent of the population. Societal expectations for food products and animal welfare have changed over these years. Today's ethical concerns of animal production and processing reflect our current understanding of the significance of animal sentience, our abundance of food, and the desires of some to control the actions of others without personal risk or responsibility versus using educational programs that create market demand to thus change the food animal system. Speakers for the first of two bioethics symposia discuss topics around the theme "The Ethics of Food Animal Production, Processing and Marketing". The first presentation covers the range of ethical arguments for and against animal use by humans (e.g., philosophy; maximizing genetic potential; realities of alternative systems; stewardship responsibilities of all size farmers). The changing social dynamics and related questions of ethics related to our food choices and marketing ethics are discussed by the second speaker. The current system was created in part by societal demand for cheap food, has altered the rural social structure, and is viewed by some as negatively impacting animal welfare. How should our society and food production system create a mutually beneficial relationship that includes concerns for animal welfare? Are there viable options to accommodate societal demands that do not create unfair burdens on farmers? The ethical aspects of controlling food animal production and processing include voluntary and involuntary options (e.g., certification programs; regulations), which the third speaker will discuss. An often-used argument against commercial animal production is harm to the environment (e.g., potential for surface and ground water contamination, ammonia, odor, worker safety, insect pests) and related societal costs, to be discussed in the final presentation. This is followed by a general discussion.

Key Words: Animal Welfare , Bioethics, Food Animals

37 The end of husbandry. B. E. Rollin*, *Colorado State University*, *Fort Collins*.

Civilization is ultimately based on agriculture, historically a contract with animals and the earth. We discuss the manner in which modern agriculture has cavalierly broken that contract. This violation ramifies in dire ethical and prudential consequences. The industrialization of agriculture has unintentionally but clearly undercut sustainability, animal welfare, and husbandry in ways we discuss in detail, and has also raised serious questions of environmental preservation, well-being of farmers and rural communities, and loss of what can be called ancestral local wisdom of the soil.

Key Words: Husbandry, Ethics, Sustainability

38 Ethical aspects of regulating production. J. C. Swanson*, *Kansas State University*, *Manhattan*.

Polls and surveys conducted within the United States show general agreement that there is public support for the protection of farm livestock and poultry. Concurrent with the growing public sentiment, is the recent adoption of socially responsible corporate policies by major food retailers relative to animal welfare. The animal welfare assurance and audit programs developed by the private sector are an attempt to assure consumers that best practice measures and independent oversight result in a reasonable quality of life for food producing animals. These programs represent voluntary self-regulation and arguably a market-based approach to secure the welfare of food producing animals. Animal advocacy organizations historically sought regulatory oversight of animal care practice. Legislative routes that require government promulgation and enforcement of animal care regulations represent an involuntary form of animal welfare assurance. There are ethical considerations concerning the employment of voluntary or involuntary regulation of the welfare of food producing animals. For example, impact on food price, viability of small to medium producers, food abundance and quality, taxpayer and government burden, and food security are prominent among the ethical considerations in deliberating involuntary regulated production. In either approach the public must be convinced that the welfare of food producing animals can be secured in a transparent and convincing manner.

Key Words: Livestock, Production, Regulation

39 Environmental aspects of ethical animal production. J. M. Siegford* and W. J. Powers, *Michigan State University*, *East Lansing*.

Livestock and poultry producers face a number of challenges including pressure from the public to be good environmental stewards and adopt welfare-friendly practices. In both arenas, producers often implement practices beyond those required for regulatory compliance in order to meet consumer demands. However, environmental stewardship and animal welfare may have conflicting objectives. Examples include pasture-based dairy and beef cattle production where high fiber diets increase methane production and subsequent release to the atmosphere compared to grain feeding practices in confinement. Grazing systems contribute to nitrate leaching to groundwater in some areas of the world where grazing is the predominant land use. Surface water impacts are of issue when grazed animals have unrestricted access to streams. Similarly, hoop housing for sows, as an alternative to indoor gestation crates, increases the risk of nutrient leaching into soil and groundwater contamination if sites are not suitably prepared. Air emissions may also increase as a result of less opportunity to trap and treat emissions. Increasing cage space and providing greater surface area per mass of excreta in any production system can increase emissions from the excreta surface. Coupling welfare-friendly and organic production practices may require greater nutrient inputs in order to reach the same production endpoint, resulting in less efficient nutrient use and greater losses to the environment. Dual systems might additionally increase environmental contamination by pathogens. When swine were housed in huts, Salmonella cycled between swine and their environment; however, population numbers of pathogenic bacteria were not different between the indoor and outdoor systems evaluated. Alternatively, these dual purpose systems may reduce antibiotic and hormonal

contaminants. When considering ethical animal production practices, consideration needs to be given to the system impacts. In most situations, welfare-friendly production requires more land units per animal or per unit of product. Consideration of energy inputs into the system may be needed as energy use profoundly affects the ecological footprint left by an operation.

Key Words: Environment, Welfare, Organic

Breeding and Genetics - Livestock and Poultry: Poultry

40 Genetic variations in chicken aggressive behavior: the role of serotonergic system. R. L. Dennis*[1,2], Z. Q. Chen[3], and H. W. Cheng[1], [1]*Livestock Behavior Research Unit, USDA-ARS*, *West Lafayette, IN*, [2]*Purdue University*, *West Lafayette, IN*, [3]*Zheijiang University, School of Animal Science*, *Hangzhou, Zhejiang Province, China*.

Serotonin (5-HT) regulates aggressive behavior via binding to its receptors, such as 5HT-1A and -1B, in humans and rodents. This study was designed to test if 5-HT regulating aggressiveness has a heritable component in chickens. Chickens from two divergently selected lines KGB and MBB (low and high aggressiveness, respectively) and DXL (Dekalb XL, an aggressive out-group) were used in the study. Hens were paired within the same strain. At 24 wk of age, the subordinate of each pair received i.p. injection of either NAN-190 (1mg/kg, a 5HT-1A antagonist, NAN), GR-127935 (1mg/kg, a 5HT-1B antagonist, GR) or saline (control) for 5 days (n= 10 per strain). Frequency of aggressive behaviors were increased in the hens of DXL and MBB treated with NAN ($P<0.05$) and in the KGB hens treated with GR ($P<0.05$), respectively. GR treated KGB hens ($P<0.05$) and NAN treated MBB hens ($P<0.05$) also displayed an increased feather pecking (FP); but neither antagonist had an effect on FP of DXL hens ($P>0.05$). This may suggest the possibility of multiple mediating factors altering FP behaviors. Among the controls, MBB hens have higher epinephrine (EP) levels than KGB or DXL hens, indicative of the inferior stress coping ability of MBB hens. Treatment with GR significantly reduced EP levels in MBB hens ($P<0.05$), but not in DXL or KGB hens, suggesting a role of 5HT-1B in stress regulation in MBB hens. Hens of all strains treated with GR but not NAN exhibited reduced weight gain and increased plasma 5-HT concentrations compared to controls ($P<0.05$), suggesting a negative feedback system altering stress coping ability. The results provide evidence for different heritable serotonergic mediation of stress coping, aggression, and FP behaviors in chickens with high and low aggressive propensities. The data also indicates that, similar to humans and rodents, 5-HT-1A and -1B have different functions in the regulation of aggressive behaviors in chickens.

Key Words: Serotonin, Aggression, Hen

41 Association between SNPs and mortality in commercial broilers: a machine learning approach. N. Long*[1], D. Gianola[1], K. A. Weigel[1], G. J. M. Rosa[1], and S. Avendaño[2], [1]*University of Wisconsin*, *Madison*, [2]*Aviagen Ltd.*, *Newbridge, Scotland*.

Genome-wide association studies using single nucleotide polymorphisms (SNPs) can identify genetic variants related to complex traits. An objective is to find sets of relevant SNPs, and to combine them in a model that predicts phenotypes of individuals or groups. Typically, there are thousands of SNPs genotyped, but the number of phenotypes is smaller. An efficient method of selecting influential SNP markers is required; subsequently, more elaborate statistical modeling work can be conducted. A 2-step feature selection method for binary traits was developed, which consisted of filtering (using information gain), and wrapping (using naïve Bayesian classification). The filter reduces the large number of SNPs to a much smaller size, to facilitate the wrapper step. Also, an approach based on discretization for dealing with continuous phenotypic values in a classification framework was developed, to enable feature selection. The methods were applied to chick mortality rates on progeny from 201 sires in a commercial broiler, with the goal of identifying SNPs (over 5000) related to progeny mortality. To mimic a case-control study, sires were clustered into two groups, low and high, according to two arbitrarily chosen mortality cut points. By varying these thresholds, 11 different "case-control" samples were formed, and the 2-step feature selection procedure was applied to each. To compare the 11 sets of chosen SNPs, an ANOVA was carried out, and p-value of overall model fit and the predicted residual sum of squares (PRESS) were used as end-points. The 2-step method improved greatly the naïve Bayesian classification accuracy over the case without feature selection (from around 50% to above 90% without and with feature selection in each case-control sample). There was consistency over the 11 case-control samples between the patterns of selected SNPs and the mutual information. The best case-control group (63 sires over or below the thresholds) had a small p-value (< 0.0001) and a relatively small PRESS value (0.59). The 17 SNPs selected using this group accounted for 36% of the variation in mortality rates across all sire groups.

Key Words: SNP-mortality Association, Machine Learning

42 Non-major histocompatibility complex effects on the outcome of Rous sarcoma virus in Arkansas Progressor and Regressor chicken lines. M. Spanakos*[1], S. M. Sullivan[1], L. K. Stamps[1], R. Kopulos[2], J. Thompson[1], G. F. Erf[1], and N. B. Anthony[1], [1]*University of Arkansas*, *Fayetteville*, [2]*Northern Illinois University*, *DeKalb, IL*.

The *B* complex, or the major histocompatibility complex (MHC) in chickens, has a direct effect on the development of Rous sarcoma virus (RSV)-induced tumors. Certain erythrocyte (*Ea*) alloantigen systems have also been shown to influence the regression of RSV-induced tumors. The objective of this study was to determine the effects of the *Ea-A* and *Ea-I* systems on the development of RSV-induced tumors within and between the Arkansas Progressor (AP) and Regressor (AR) chicken lines. The interactions between the *Ea-A* and *Ea-I* loci and the *B* complex were also examined. The AP line (B^{13}) has two segregating alleles at the *Ea-A* (A^4 and A^5) and *Ea-I* (I^2 and I^8) loci, while the AR line (B^{13} and B^{221}) is fixed at the *A* locus (A^4). Tumors were scored three times a week for a 10-week period. Pattern of response to the tumor was evaluated using tumor score (TS), tumor profile index (TPI), and mortality. Birds with the AP B^{13}, AR B^{13}, and AP B^{13}/AR B^{13} backgrounds and I^2I^8 haplotype had higher TS, TPI and mortality compared to those with the homozygous *Ea-I* combinations. A similar effect was seen with the *Ea-A* heterozygotes as compared to homozygotes in the AP B^{13}, and AP B^{13}/AR B^{13} backgrounds. Tumor

regression efficiency declined even further when an individual was heterozygous at both the *Ea-A* and *Ea-I* loci in the AP B^{13}, and AP B^{13}/AR B^{13} backgrounds. The observed decline in the efficiency of tumor regression as heterozygosity at the *Ea-A* and *Ea-I* loci increased suggests a dosage effect of the *Ea-A* and *Ea-I* systems. However the effects of the *Ea-A* and *Ea-I* loci seemed to be suppressed when the B^{221} allele was present. This suggests that the *B* locus has an epistatic effect on the *Ea-A* and *Ea-I* systems. Hence, in the AP and AR lines the effects of the *Ea-A* and *Ea-I* loci on the response to RSV challenge are expressed in the presence of the B^{13} allele.

Key Words: MHC, Erythrocyte Alloantigen Systems, Rous Sarcoma Tumor

43 Animal model estimation of (Co) variance components and genetic parameters for most important economic traits in Iranian native fowl. A. Ghazi Khani Shad*[1], A. Nejati Javaremi[2], and H. Mehrabani Yeganeh[2], [1]*Azad University of Science and Research*, *Tehran, Iran*, [2]*University of Tehran*, *Iran*.

(Co)Variance components and genetic parameters for economic traits in Iranian native fowls were estimated using multivariate animal model analysis with DFREML procedure. The data of four stations of native fowls breeding (Mazandaran:n= 49536, Esfahan:n= 23108, West Azarbaijan:n= 24890 and Fars: n=30279) was containing records of cocks and hens collected during period of 1988 to 2006. The recorded traits were body weight (at 8 weeks or 12 weeks), ge at first egg, egg number at 12 first weeks of production and mean egg weight between 28 to 32 weeks. The most estimated heritabilites, except egg number, were more than 0.20. The highest heritabilites for all traits were related to Fars station, whereas most heritabilites in West Azarbaijan were less than other stations. The heritability for egg number was estimated 0.099 ± 0.018 for Esfahan to 0.322±0.012 for Fars. The estimated heritabilities of body weight were medium to high and varied from 0.228 ± 0.014 for Esfahan to 0.548 ± 0.014 for Fars, While, the heritabilities of mean egg weight were high and ranged from 0.223 ± 0.021 for West Azarbaijan to 0.638 ± 0.013 for Fars. The heritability for Age at first egg was estimated 0.270 ± 0.021 for Esfahan to 0.520 ± 0.014 for Fars. The most estimated genetic correlations, except between Body weight and Egg weight and between age at first egg and egg weight, were negative.The direct genetic correlations between maturity age and egg number were high and negative, ranging from -0.384 ± 0.033 to -0.987 ± 0.003 for Mazandaran and Fars, respectively.

The estimated Heritabilites ± standard errors for BW, AFE, EN12 and MEW

	Mazandaran	Fars	West Azarbaijan	Esfahan
BW	0.279±0.009	0.548±0.014	0.254±0.014	0.228±0.014
AFE	0.346±0.012	0.520±0.014	0.276±0.027	0.270±0.021
EN12	0.158±0.009	0.322±0.012	0.099±0.018	0.185±0.019
MEW	0.458±0.012	0.638±0.014	0.223±0.021	0.246±0.022

BW, AFE,EN12 and MEW are body weight, age at first egg,egg number and mean egg weight, respectively

Key Words: Economic Traits, Heritability, Genetic Correlation

44 Effects of competition on expected response to selection for ADG. C. Y. Chen*[1], R. K. Johnson[1], S. D. Kachman[1], and L. D. Van Vleck[1,2], [1]*University of Nebraska*, *Lincoln*, [2]*ARS, USDA, U.S. Meat Animal Research Center*, *Clay Center, NE*.

The objective was to investigate the importance of competition effects on expected response to selection for average daily gain (ADG, g) of boars. A total of 9,720 records from dam lines (1 and 2) and sire lines (3 and 4) were available with 15 boars per pen. Gains (ADG) were measured from about 71 to 161 d of age and weight from 31 to 120 kg. Four models for EBV were compared; each included initial age on test as a covariate and fixed effect of contemporary group (farm-year-season). Direct genetic (d) and competition genetic (c) effects were included in models as random effects. Pen (pn) was included in some models as fixed and in other models as random factors. Models were: Model 1 (d, c, pn random) as full model, Model 2 (d and c), Model 3 (d and pn random), and Model 4 (d, pn fixed). Estimates of direct heritability with Model 1 obtained with MTDFREML for ADG were 0.31, 0.39, 0.21, and 0.26 for lines 1-4. Estimates of heritability of competition effects were near zero. Model 2 produced slightly larger estimates of competition variances ($P<0.05$ for lines 1-3). Expected responses to selection were calculated under the assumption that estimates of parameters from Model 1 were unbiased. For response of one genetic SD for both components (d and c), the proportions of expected total gain due to competition effects (with economic weights of 1 for each with pen size of 14) were 53, 19, 62, and 58% for the 4 lines. Rank correlations within lines were: 0.87-0.95, 0.51-0.99, and 0.36-0.97 between Model 1 and Models 2, 3, and 4. Genetic gains were calculated with pigs ranked on reduced models, but with EBV calculated with the best model (Model 1). Average total breeding values ($TEBV=EBV_d +14EBV_c$) for the top 10% of boars selected with Model 1 were 83, 110, 42, and 102 g for lines 1 to 4, respectively. For rankings based on Model 3, but EBV calculated with Model 1, average TEBV for the top 10% were 76, 110, 18, and 95 g and for rankings based on Model 4 were 66, 108, 12, and 87 g. Further study of correlated responses with models including competition effects seems warranted.

Key Words: Competition, Response to Selection, Swine

45 Effect of sex and sire on the intramuscular fatty acid profile in pigs. S. De Smet*[1], M. Ntawubizi[1], K. Raes[1,3], and N. Buys[2], [1]*Laboratory for Animal Nutrition and Animal Product Quality, Department of Animal Production, Ghent University*, *Melle, Belgium*, [2]*Centre for Animal Genetics and Selection, Catholic University Leuven*, *Heverlee, Belgium*, [3]*University College of West-Flanders, Department PIH*, *Kortrijk, Belgium*.

Intramuscular (IM) fatty acid (FA) composition is affected by dietary and genetic factors. The aim of this study was to investigate the effect of sex and sire on the IM FA profile of pork. Indices reflecting activities of desaturase and elongase enzymes involved in FA metabolism were calculated as ratio's of product to precursor FA proportions. The *Longissimus dorsi* from 123 animals (n = 61 castrates and 62 females) originating from 5 boars (n = 24-26 per boar) was analysed for FA composition. Pigs were all fattened on the same diet, and were slaughtered at a live weight of approximately 110 kg. The results of the FA proportions (g/100g FAME) were analysed using a General Linear Model with sex and sire as fixed effects (sex x sire interaction term not significant), and IM fat content as covariate to account for variation in the FA proportions due to differences in fatness. The IM fat

content had a highly significant effect on all individual polyunsaturated FA (PUFA) proportions, except C18:3n-3. The sum of n-6 and n-3 PUFA proportions were higher in females compared to castrates ($P<0.05$). Sire had no effect on the sum of n-6 PUFA, but affected the sum of n-3 PUFA ($P<0.001$). An effect of sire ($P<0.05$) but not of sex was observed for several indices reflecting de('Δ');9-desaturase activity. A significant ($P<0.001$) effect of sire was observed for most indices reflecting desaturase and elongase activities involved in the n-3 PUFA metabolism. A moderate effect of sex was found, with a higher capacity of females compared to castrates to elongate and desaturate C18:3n-3 to longer chain FA. The effects of sex and sire on the indices calculated within the n-6 PUFA series were less marked. The data suggest considerable genetic variability for the long chain PUFA metabolism independent of the level of fatness.

Key Words: Polyunsaturated Fatty Acids, Elongase/Desaturase Activity, Pig Muscle

46 Assessing hepatic gene expression in response to xenobiotic exposure. S. Boorgula*, D. J. Blodgett, M. Carlidge, S. Blevins, J. Boothe, and R. M. Lewis, *Virginia Polytechnic Institute and State University*, *Blacksburg*.

Xenobiotics from plant derived foreign chemicals are metabolized in liver when ingested. Phase I liver enzymes may change non-polar xenobiotics into reactive metabolites, thereby increasing toxicity. Phase II enzymes help inactivate these metabolites by addition of water-soluble groups and by their excretion in urine or bile. Some genes affecting expression of phase I enzymes are cytochrome P450 (Cyp) 1a2 and flavin mono-oxygenase (FMO) 1; and phase II enzymes are glutathione-S-transferase mu (Gstm) 1 and quinone reductase (Nq) 02. Xenobiotics of interest are ergotamine (ET), associated with fescue toxicosis, and sulforaphane (SFN), considered a phase II enzyme inducer. Although effects of SFN on phase I genes are unclear, ET is generally metabolized by phase I enzymes. Our objective was to test whether predicted variation in liver enzyme activity and gene expression occurred with exposure to these xenobiotics. Polymorphic mice (ICR, Harlan Sprague Dawley) were orally dosed for 2, 5, 8 or 11 d with either SFN (2.5 mg•mouse^{-1}•d^{-1}) or ET (0.6 mg•mouse^{-1}•d^{-1}) or control ($n \geq 5$ for each period and treatment). Control was a 50:50 mix of dimethyl sulfoxide and water, a vehicle used for diluting SFN and ET. Mice were killed 24h after last dosing and livers collected. Real time PCR revealed increase in expression ($P \leq 0.05$) of Cyp1a2 in both treatments relative to control on d 5, while FMO1 expression increased ($P \leq 0.05$) on d 11 in only SFN treated mice. Increase ($P < 0.05$) in expression of transcription factor, Nuclear factor-erythroid 2 p45-related factor 2 (Nrf2) and Nq02 ($P < 0.05$) gene on d 5 was followed by increase in Gstm1 expression ($P < 0.05$) on 8 and 11 d in SFN treated mice. Activity of Nq enzyme was decreased ($P < 0.05$) on d 8 in ET treated mice. Although, the down stream metabolism of FMO1 is not well documented, previous studies showed that Cyp1a2 inducers are deactivated in the presence of Gstm1. Thus, polymorphic mice, showing similarity in phase I gene (Cyp1a2) expression, but disparity in phase II gene (Gstm1 and Nq02) induction and enzyme activity, exhibited variable liver enzyme expression when challenged with different xenobiotics.

Key Words: Xenobiotics, Phase I and II Enzymes, Real Time PCR

47 Characterization of newly developed chicken 44K Agilent microarray. X. Y. Li*, H. I. Chiang, J. Zhu, and H. Zhou, *Texas A&M University*, *College Station*.

The development of high quality, reliable microarray resources for the chicken scientific community is an important step for avian functional genomics study. A new chicken 44K 60-mer oligonucleotide microarray featuring entire Marek's disease virus, avian influenza virus genomes, 150 chicken microRNAs and all gene models for the chicken genome has been developed on the Agilent platform. This new array provided a platform with four independent 44K arrays per slide. To characterize this array, four major tissues: liver, spleen, cecal tonsil, and ileum were collected from 6 commercial broilers and total RNA was isolated for hybridization to the microarray. A loop design was used to compare between every two tissues with dye swap and there were four biological replicates for each comparison. In total, 24 arrays were used in the current study. The signal intensity of each gene was normalized using LOWESS implemented in the R programming environment. More than 95% of spots had high signal to noise ratio (more than 10). A mixed model including fixed effects for tissue and dye was used to identify differentially expressed genes. There were 3710, 3355, 3208, 2886, 2660, and 358 genes significantly differentially expressed between spleen and ileum, liver and ileum, liver and cecal tonsil, liver and spleen, spleen and cecal tonsil, as well as cecal tonsil and ileum ($P<10^{-7}$) with corresponding false discovery rate (FDR) of 4.46×10^{-7}, 4.14×10^{-7}, 4.37×10^{-7}, 5.02×10^{-7}, 7.39×10^{-7} and 9.11×10^{-6}, respectively. Three to four hundred differentially expressed genes were more than 10-fold different for each comparison, except between cecal tonsil and ileum (18 genes). There existed 560, 108, 96, and 71 genes specifically expressed in liver, spleen, cecal tonsil, and ileum, respectively ($P<10^{-7}$). The results showed that this newly developed chicken oligonucleotide array is very informative and tissue-specific. This powerful genomic tool will provide a solid foundation for the further investigation in the areas of immunology, genetics, nutrition, and food safety in chickens.

Key Words: Chicken, Microarray, Functional Genome

48 Sources of variation in meat and carcass quality of pigs. E. F. Knol*, K. A. Engelsma, and J. W. M. Merks, *Institute for Pig Genetics (IPG)*, *Beuningen, The Netherlands*.

Predictable uniform pork quality is the goal for slaughter plants. 2526 animals of six sire lines and four dam crosses were born and raised on a Western European commercial farm and slaughtered and dissected in a large commercial slaughter plant to represent a standard situation. Phenotypic variation in 16 meat and 2 carcass quality traits was analyzed with ASReml and attributed to day of slaughter, weight, feeding system, sex, sire line, dam cross, litter and individual genetic variation. Heritabilities in strict sense were in line with literature values. Ratio between influence of sire line*dam cross and influence of slaughter day differed between 0.3 (Japanese color scale (JCS)) and 3.0 (drip loss) for meat quality. Recorded traits (h^2 ±SE) were: JCS loin (0.20 ±0.05), JCS inner ham (0.12 ±0.05), JCS outer ham (0.22 ±0.06), Minolta L (0.37 ±0.06), Minolta a (0.34 ±0.06), Minolta b (0.25 ±0.06), pH loin (0.23 ±0.05), pH ham (0.17 ±0.05), IMF (0.54 ±0.17), marbling loin (0.24 ±0.05), marbling ham (0.10 ±0.04), drip weight (0.23 ±0.06), drip score (0.15 ±0.05), drip loss (0.17 ±0.05), purge (0.18 ±0.06) and conductivity (0.27 ±0.06). For the two most relevant carcass traits (h^2 ±SE): deboned loin weight (0.28 ±0.06) and deboned ham weight (0.36 ±0.06). Genetic correlations between meat

quality traits show opportunities for indirect measurements (Minolta, pH and conductivity), they also show possibilities for simplified measurements (drip score). Heritabilities are interestingly high. Repeated meat quality measurements will further decrease the error term and increase the effective heritability. Uniformity in meat quality can be improved by using uniform sire line*dam cross, standardized shipping and processing, and genetic selection.

Key Words: Meat Quality, Variation, Heritability

49 Using a web-based economic model to examine investment decisions in the turkey industry for both integrated and non-integrated companies. B. J. Wood* and N. Buddiger, *Hybrid Turkeys*, *Kitchener, Ontario, Canada*.

An economic model for both integrated and non-integrated turkey production companies was created for use as a web-based management tool. Modeling turkey production was possible as all variables, from the supply of parent stock (PS) through to carcass processing and sale of final product, were readily quantified. Costs of production included PS and hatching costs related to poult production, feed, housing and labor for both the poult and commercial live production and finally manufacturing costs in the processing plant. Returns were generated though the sale of processed final product. At each level manipulation of PS strain, feed, labor, housing and processing had an effect on profitability and to accurately access the impact of each, the model should reflect the change in profitability of the system when production parameters were altered. Parameters higher in the production chain such as commercial poult cost and PS selection affected lower elements in the model such as the live production cost which ultimately affects the gross margin. Price volatility in feed and breast meat price were modeled with Gompertz-type growth and feed intake equations. This allowed optimal slaughter age or weight windows to be calculated based on feed price and processed product value. As feed price decreased or processed breast meat price increased the optimal slaughter weight also increased, conversely, with increased feed or lower breast meat price, the opposite was true, with a decrease in the optimal slaughter weight because of lower feed efficiencies at later ages. In each case, a decision on investment in feed and facilities must be made. Economic modeling can increase profitability via the ability to identify areas in which changes in management or investment can be made to improve performance. By examining the profit to investment ratio, investment may be made in an economically rational manner with funds channeled to areas that best increase the profit to investment ratio.

Key Words: Economic Model, Turkeys, World Wide Web

50 Quantitative and biological issues of feed utilization efficiency. S. E. Aggrey*, *University of Georgia*, *Athens*.

Most parametric statistical tests assume an additive rather than proportional error model. Since FC and BWG do not have similar distributions, the ratios of the two tend to be asymmetric (skewed). This violates the normality assumption the normality assumption of most statistical tests. The central limit theorem affords little protection for most skewed distributions, and when the sample size is small, the P-values associated with parametric tests like the t-test and ANOVA is incorrect. Summary statistics of FCR and FE yield different quantities. Log (any base) transformation of FE and FCR has the advantage of transforming the error model from a proportional to an additive one because log (FC/BWG)=log (FC) – log (BWG). Distributions of log values and consequently log ratios tends to be normal. Summary statistics of log ratios yield the same quantities, regardless of numerator/denominator assignments. The difference in sign of the means reflects whether on average the numerator is larger [+] or smaller [-] than the denominator. Taking the antilog of the average log ratios returns the data to a fold-metric.

Key Words: Feed Conversion Ratio, Feed Efficiency, Log Transformation

Egg and Meat Science and Muscle Biology - Livestock and Poultry: Meat Packaging and Shelf Life

51 Overview of meat life cycle from harvest to consumer. R. D. Huffman*[1] and J. C. Brooks[2], [1]*American Meat Institute Foundation*, *Washington, DC*, [2]*Texas Tech University*, *Lubbock*.

The harvest, processing and distribution of perishable meat products presents myriad challenges with respect to maintaining optimum quality and safety attributes. Frequently, the marketing term ″fresh″ is used to describe desirable product attributes and conversely, the term ″spoiled″ may be used to describe product that is no longer desirable for consumption. Product safety however is an attribute that should be decoupled from these product quality descriptors. When livestock are harvested, there exists an intrinsic potential for shelf life of the products derived from the carcass. The meat processing sector has developed numerous innovative means of protecting the integrity of raw meat products and maximizing potential shelf life of each product type. The processing steps and appropriate application of technology will determine how closely potential shelf life is maximized. This paper will describe the life cycle of meat products from the point of slaughter to the point of consumption, and attempt to clarify the meaning of the terms “fresh” and “spoiled.” The history of meat preservation dates back centuries and involves such important innovations as the first uses of salt in ancient times and the advent of mechanical refrigeration in the 1930’s. No doubt, these innovations were critical to the evolution of meat preservation; however, the most important recent innovation for increasing raw product shelf life is widespread adoption of vacuum packaging. Recent innovations have enabled the processing sector to further maximize fresh shelf life. Three major factors contribute to raw meat deterioration, 1) microbiological growth, 2) oxidation of lipids and 3) enzymatic activity. These factors are not mutually exclusive and in fact may interact to ultimately determine the end of shelf life. Optimum refrigeration at critical points in the harvest process, time and temperature controls throughout processing and distribution, reduction or elimination of oxygen exposure through packaging, and reduction of UV light exposure are all control methods that will mitigate the three factors that lead to product deterioration.

Key Words: Meat, Packaging, Shelf Life

52 Defining spoilage: What is shelf life and how is it determined? T. L. Brown[1], S. L. Jaax[1], M. M. Brashears[2], and S. J. Eilert*[1], [1]*Cargill Meat Solutions*, *Wichita, KS*, [2]*Texas Tech University*, *Lubbock*.

The objective of this review paper is to discuss the definitions and methods used to determine the shelf life of meat products. Predicting shelf life accurately impacts multiple facets of the food industry, including production, consumers and regulatory compliance. The economic impact of shelf life on consumer confidence and market position can be dramatic. The effort spent on modifications to formulation and packaging in attempt to maximize shelf life and product quality can be staggering. Shelf life is defined as the length of time that food and other perishable items are given before they are considered unacceptable for sale from a sensory, nutritional or safety perspective. Microbial growth or predictive microbiology is widely used to determine shelf life. To use microbial data requires making the assumption that a product has reached the end of its shelf life when the microbial count reaches a predetermined level. This assumption is usually made based on historical knowledge of the product. Even with an abundance of historical product knowledge, statements regarding shelf life based on microbial data may not hold true. Microbial growth rates are affected by product type, formulation, packaging, storage conditions, beginning microbial load, and many other variables. Some products will be considered spoiled at a low microbial load due to physical characteristics like odor, color or gas production. However, other products containing an excessive microbial load will still be acceptable referring to the definition of shelf life. Traditional microbial counts or predictive microbiology does not determine if a product is spoiled. Shelf life or product acceptability is a measure of product quality not microbial counts. Microbial counts may give an indication about the product stability but will not determine shelf life. Chemical or physical measurement is a more accurate gauge of shelf life by observing nutritional degradation or sensory acceptability.

Key Words: Shelf Life, Spoilage, Meat

53 Is there a link between food safety and food spoilage? J. C. Brooks*, M. M. Brashears, and M. F. Miller, *Texas Tech University*, *Lubbock*.

Microbial food safety is a general term that refers to the presence of harmful or pathogenic bacteria in foods that could cause human illness if consumed. Spoilage is a subjective measurement of quality and includes chemical and/or physical changes in color, texture, odor, taste, and microbial counts. Some researchers believe controlling microbial growth is the most important factor in controlling the spoilage of meat and choose to measure spoilage by quantifying bacteria. This practice of measuring bacteria as an indicator of spoilage has resulted in a perceived relationship between spoilage bacteria counts and pathogenic bacteria counts. This perception has been supported by several research scientists who have documented their concern that certain packaging techniques, namely Modified Atmosphere Packaging, may inhibit the growth of microorganisms that are typical indicators of spoilage to consumers and promote the growth of food pathogens. To determine if a link exists between food safety and spoilage, studies were conducted to measure the spoilage (trained and consumer panels for color and odor; total aerobic plate counts, coliforms, and lactobacillus bacteria; and oxidative rancidity) and safety (Escherichia coli O157:H7 and Salmonella spp inoculated samples) characteristics of ground beef and poultry packaged under low-oxygen and high-oxygen modified atmospheres. Results indicate food pathogen levels are not related to food spoilage (microbial and sensory traits) in ground beef patties packaged under high-oxygen and low-oxygen (with 0.4% CO) modified atmospheres. Similar results were observed for chicken drums and breast meat packaged in low-oxygen environments containing 0.4% CO. The lack of data to support a relationship between food safety and food spoilage is likely the result of several factors affecting the chemical and physical changes that occur during the storage of meat products. Storage temperature, package atmosphere, light intensity, meat constituents, initial microorganism loads, indigenous enzyme activity and consumers collectively define food spoilage and appear to have little effect on the growth and survivability of food pathogens under controlled conditions.

Key Words: Spoilage, Safety, Packaging

Food Safety - Livestock and Poultry: Current and Future Salmonella Challenges

54 Gastrointestinal microbial ecology and the safety of our food supply as related to *Salmonella*. T. R. Callaway*, T. S. Edrington, J. A. Byrd, R. C. Anderson, R. B. Harvey, K. J. Genovese, J. L. McReynolds, and D. J. Nisbet, *Food and Feed Safety Research Unit*, *College Station, TX*.

Salmonella causes an estimated 1.3 million cases of human illnesses and more than 500 deaths annually in the U.S. This was estimated at an annual cost to the economy of approximately $2.9 billion. *Salmonella enterica* is comprised of more than 2,500 serotypes. With this genetic and environmental diversity serotypes are adapted to live in a wide variety of hosts using non-pathogenic and pathogenic lifestyles depending on environmental conditions. Thus *Salmonella* presents a multi-faceted threat to food production and safety. *Salmonella* have been isolated from all food animals and can cause morbidity as well as mortality in swine, cattle, sheep, and poultry. The link between human salmonellosis and host animals is most clear in poultry. During the early part of the 20th century a successful campaign was waged to eliminate fowl typhoid caused by *Salmonella* Gallinarum/Pullorum. Microbial ecology is much like macroecology; environmental niches are filled by adapted and specialized species. Elimination of *S.* Gallinarum cleared a niche in the on-farm and intestinal microbial ecology that was quickly exploited by *S.* Enteriditis and other serotypes that live in other hosts, such as rodents. In the years since, human salmonellosis cases linked to poultry have increased to the point that uncooked chicken and eggs are regarded as toxic in the zeitgeist. Salmonellosis caused by poultry products have increased significantly in the past 5 yr, leading to federal efforts that target reducing the incidence of *Salmonella* in chickens below the current 19% rate. Prevalence of *Salmonella* in swine and cattle is lower, but still poses a threat to food safety and production efficiency. Thus, approaches to reducing *Salmonella* in animals must bear in mind that the microbial ecology of the animal is a critical factor that must be accounted for when designing intervention strategies. Competitive exclusion, sodium chlorate, vaccination, are bacteriophage are all strategies that can reduce *Salmonella* in the live animal, but it is vital to understand how they function.

Key Words: *Salmonella*, Preharvest Strategies, Food safety

55 Current and future *Salmonella* challenges: Background, serotypes, pathogenicity, and drug resistance. S. L. Foley*, *Marshfield Clinic Research Foundation*, *Marshfield, WI*.

Salmonellosis is a worldwide health problem and *Salmonella* infections are the second leading cause of bacterial foodborne illnesses in the U.S. Approximately 95% of human salmonellosis cases are associated with consumption of contaminated foods such as meat, poultry, eggs, milk, seafood, and fresh produce. *Salmonella* can cause a number of human illnesses that include enterocolitis, bacteremia, and typhoid fever, with the most common being enterocolitis. Enterocolitis is often characterized by abdominal pain, nausea and vomiting, diarrhea, and headache. Typically the illness is self-limiting, but antimicrobial therapy is often needed to treat more severe infections. Currently, there are over 2,500 identified serotypes of *Salmonella*. A smaller number of these serotypes are significantly associated with animal and human illnesses. These include Typhimurium, Enteritidis, Newport, Heidelberg, Muenchen, and Montevideo. Isolates from these serotypes are more frequently detected demonstrating resistance to multiple antimicrobial agents, especially third generation cephalosporins that are recommended for treatment of severe infections. Many of the genes encoding resistance are located on transmissible elements such as plasmids to allow for potential transfer of resistance among strains. Plasmids are also known to harbor virulence factors that contribute to *Salmonella* pathogenicity. Several serotypes of medical importance such as Typhimurium, Enteritidis, Newport, Dublin, and Choleraesuis are known to harbor virulence plasmids containing genes encoding for fimbriae, serum resistance, and other factors. Additionally, many *Salmonella* contain pathogenicity islands scattered throughout their genomes to encode factors essential for bacterial adhesion, invasion, and infection. *Salmonella* have evolved several virulence and antimicrobial resistance mechanisms that allowed for continued challenges to our public health infrastructure.

Key Words: *Salmonella*, Pathogenesis, Antimicrobial Resistance

56 Current and future *Salmonella* challenges: Prevalence of *Salmonella* in beef and dairy cattle and potential pathogenicity of their isolates. C. R. Jackson*, P. J. Fedorka-Cray, J. Haro, and B. M. McGlinchey, *USDA-ARS*, *Athens, GA*.

Salmonella is a leading cause of foodborne illnesses that spread to humans from different sources. While all *Salmonella* serotypes have the potential to cause illnesses, certain serovars appear to be responsible for various illnesses in animals and humans. *Salmonella* Typhimurium, *S.* Enteritidis, and *S.* Newport are in the top five serotypes implicated in human infections whereas *S.* Dublin is a common cause of cattle infections. As a part of the National Antimicrobial Resistance Monitoring System (NARMS), prevalence, antimicrobial susceptibility, and pulsed-field gel electrophoresis of *Salmonella* serotypes in beef and dairy cattle collected from 1997 to 2005 were examined. A total of 10,228 and 4,584 *Salmonella* isolates from beef cattle and dairy cattle, respectively, were tested. For beef cattle, the clinical status of the isolates included slaughter (n = 6,813; 61.3%), diagnostic (n = 3,415; 30.7%), and on-farm (n = 883; 8.0%). For dairy cattle, the clinical status included diagnostic (n = 3,036; 66.2%) and on-farm (n = 1,548; 33.8%). For samples from beef cattle at slaughter, the top three serotypes were *S.* Montevideo (13.9%), *S.* Anatum (8.9%), and *S.* Newport (7.6%). For diagnostic isolates, the top three serotypes from both beef and dairy cattle were the same, but were ranked differently: *S.* Typhimurium var. 5- (15.8%), *S.* Newport (13.6%), and *S.* Typhimurium (13.1%) from beef cattle and *S.* Newport (24.3%), *S.* Typhimurium (19.7%), and *S.* Typhimurium var. 5- (18.6%) from dairy cattle. Regardless of the source, 51.9% of all *Salmonella* from cattle were pan-susceptible in 2005. Through 2005, 45.4% of *S.* Typhimurium, 24.6% of *S.* Newport, and 13.4% of *S.* Typhimurium var. 5- from slaughter samples were pan-susceptible. Multidrug resistance (resistance to two or more antimicrobials) was 80.2% for *S.* Typhimurium var. 5-, 74.8% for *S.* Newport, and 52.0% for *S.* Typhimurium. Using PFGE, the most common pattern for all cattle isolates was for *S.* Newport (n = 165). The results demonstrated the differences between beef and dairy cattle in prevalence of *Salmonella* serotypes.

Key Words: *Salmonella*, Cattle, Serotypes

57 Current and future *Salmonella* challenges: Prevalence in swine and poultry and potential pathogenicity of their isolates. S. L. Foley*, *Marshfield Clinic Research Foundation*, *Marshfield, WI*.

Salmonella infections are the second leading cause of bacterial foodborne illness in the U.S. The great majority of these infections are associated with consumption of foods such as meat, poultry, eggs, milk, seafood, and fresh produce contaminated with *Salmonella*. The per capita consumption of meat and poultry in the U.S. has increased significantly over the past century. This increase is especially evident with poultry products, where there has been a nearly six-fold increase in chicken consumption and 17-fold increase in turkey consumption since 1909. The annual per capita consumption of pork has also increased over that time from 18.7 to 21.7 kg. With these increases in consumption, the dynamics of animal production and consumer exposure have changed leading to new challenges in limiting salmonellosis. To meet the high demand of consumers, more intensive agricultural practices have been adopted. This has likely changed the population characteristics of *Salmonella* present among poultry and swine populations. With regard to *Salmonella* isolated from swine in the U.S., Typhimurium has replaced Choleraesuis as the predominant serovar in recent years. Among isolates collected from turkeys in 2004, serovars Senftenberg and Hadar were most common. However, Heidelberg was most common from clinical sources, potentially indicating increased virulence. Heidelberg was also the most commonly detected serovar in clinical and non-clincal isolates from chickens. A high percentage of isolates from many of these prominent serovars are resistant to antibiotics. Public statistics suggested that antimicrobial use in the U.S. has increased at least 30-fold over the past 50 yr. This increase has likely provided selective pressure to drive proliferation of antimicrobial resistance and potentially select for transfer of virulence factors. This can be physically associated with resistance genes that lead to increased pathogenicity among *Salmonella* strains.

Key Words: *Salmonella*, Swine, Poultry

58 Temporal variables of the Quarter Horse hunter trot and canter. M. Nicodemus*, *Mississippi State University*, *Mississippi State*.

American Quarter Horse (QH) is the largest breed in the United States with hunter under saddle (HUS) ranking as one of the highest in number of entries for rail classes. However, kinematic research on stock-type horses and on HUS horses is lacking. Research has studied the kinematics of nationally ranked stock-type western pleasure horses finding horses won at competitions while performing gaits that did not follow breed association guidelines. This research assisted in changes to improve upon the gait definitions of the western pleasure horse. Therefore, objectives of this study were to measure the temporal variables of the trot and canter of the QH HUS horse and to define using measured gait variables the gaits that are winning at competitions. 6 registered QH showing in a HUS class were filmed at 60 Hz. Camera was set perpendicular to horse's plane of motion at a distance of 399.2 cm. Horses were filmed throughout the class along one of the long sides of the arena. Trot and canter strides judged as desirable by carded QH judges under breed standards were evaluated using frame-by-frame analysis. Judging guidelines are documented in the 2006 QH rulebook under the HUS section. Strides not considered "desirable" were not included as the study objectives were to only define the locomotion of those horses winning at competitions. Means (SD) were determined for 5 strides for each horse for each gait with stance and limb support given as % of stride. Fore (Right=40±2%, Left=40±3%) and hind (Right=40±3%, Left=40±2%) stance were balanced in the trot, while the diagonal limbs of the canter were balanced (Trailing Fore=46±5%, Leading Hind=46±5%;Trailing Hind=41±3%, Leading Fore=42±4%). Along with suspension and bipedal support, the canter demonstrated periods of single fore (27±4%), single hind (20±3%), tripedal with 2 hind (20±4%), and tripedal with 2 fore (15±4%) supports (Table 1). In conclusion, the understanding of kinematics of the QH HUS horse can assist in performance evaluation. The measured variables from this study can be used to better define the HUS gaits according to QH breed association guidelines.

Table 1: Means (SD) of the temporal variables of the Quarter Horse hunter trot and canter.

	Trot	Canter
Velocity (m/s)	2.83±0.31	3.22±0.33
Stride Duration (ms)	773±43	623±27
Stride Length (m)	2.19±0.25	2.01±0.23
Stride Rate (stride/s)	1.30±0.07	1.61±0.07
Suspension (%)	19±1	7±4
Bipedal Support (%)	81±1	10±5

Key Words: Hunter Under Saddle, Quarter Horse, Temporal Variables

59 Survey of working conditions and management of donkeys in Niono and Segou. M. M. Diarra[1], A. Doumbia[1], and A. K. McLean*[2], [1]*Institut Polytechnique Rural de Formation et de Recherche Appliquèe*, *Katibougou, Mali*, [2]*Michigan State University*, *East Lansing*.

Donkeys, *Equus asinus*, play a vital role in the agriculture based economy of Mali, where they are used primarily by low income farmers for traction and to generate additional income by providing transportation of crops to market and a source of manure for fertilizer. The breakdown of donkeys caused by adverse conditions and poor health can lead to their unavailability for periods lasting from one to six months, often leading to abandonment due to the cost of care and lack of productivity. The objective of this survey was to identify the most common existing causes of poor health and reduced ability to work that could be rectified by better management strategies. The maintenance procedures of 2,656 donkeys in two locations in Mali, Niono (n=1448, 6 mo. duration) and Segou (n=1208, 8 mo. duration) were recorded by a veterinarian. Donkeys were examined monthly and evaluated with respect to their ability to work. Variables analyzed included the number of donkeys per owner, the use of the donkey, quality of harness, daily distance traveled, type of goods transported, hours worked per day, feed and watering practices, problems treated by the owner such as lesions caused by poor harnesses or lameness that impaired ability to work. The most prevalent causes of reduced work output were poorly constructed and fitting harnesses (76%), overloading (51% carried loads over 500 kg, the FAO recommends 400 kg), traveling long distances (79% traveled over 20 km/day), and for long hours (82% worked longer than 6 hr). In Segou (67%) and Niono (75%) of the donkeys had adverse health conditions such as lesions on the withers and shoulders, lameness, parasites, tetanus, trypanosomiasis and inanition. No medical care was provided to 72% of these animals especially with parasites and lesions. Harness quality is believed to be directly related to frequency of the lesions and wounds. These data highlight the need for education on donkey work practices, harnessing, and husbandry to improve the quality of life and work of these essential animals.

Key Words: Donkeys, Mali, Survey

60 11 β- hydroxysteroid dehydrogenase type 1 activity in equine adipose tissue. F. H. G. Farias*, P. J. Johnson, V. K. Ganjam, and D. H. Keisler, *University of Missouri*, *Columbia*.

Enzymatic 11βHSD1 amplification of glucocorticoid concentration in adipose tissue has been associated with obesity, diabetes, hypertension, dyslipdemia, and cardiovascular disease in humans and mice. Furthermore, mice that over-express 11βHSD1 activity in adipose tissue exhibit characteristics of visceral obesity and metabolic syndrome. Analogous to the growing problem of obesity and related problems in humans, the incidence of obesity and related problems are on the rise in the horse industry. In horses, obesity predisposes to greater risk for laminitis, infertility, insulin resistance, and equine metabolic syndrome. Our objective was to determine if 11βHSD1 activity exists in horse adipose tissue and, if present, to quantitate the amount of activity in abdominal vs. subcutaneous fat depots. Our hypothesis was that 11βHSD1 is present in horse adipose and that its activity is more abundant in abdominal vs. subcutaneous fat depots. Thus, samples of abdominal (retro-peritoneal) and subcutaneous (base of the tail) adipose tissue were collected from 23 horses. Horse body condition scores were categorized as obese (7-9), subtle overweight (6), normal (4-5), and thin (1-3). Fat samples from each adipose depot were submitted for immuno-histochemistry procedures to detect the presence of 11βHSD1 in abdominal and subcutaneous adipose tissue. In addition, radiometric assay procedures were also used to reaffirm the presence and quantitate the activity of 11βHSD1 in abdominal and subcutaneous

adipose tissue locations. Data were analyzed by PROC GLM and PROC MIXED of SAS, significance was set at P<0.05. We found no difference in 11βHSD1 activity between subcutaneous and abdominal adipose tissue nor did its activity correlate with body condition scores. These data provide evidence that 11βHSD1 activity is present in horse subcutaneous and abdominal adipose tissue, but these data fail to provide evidence that body condition score and 11βHSD1 activity are correlated as reported to occur in humans.

Key Words: Horses, 11β-HSD

61 Glucose/insulin responses of weanling horses fed forage based total mixed ration cubes versus hay/concentrate rations. S. L. Ralston*[1], H. Anderson[2], and R. Johnson[3], [1]*Rutgers*, *New Brunswick, NJ*, [2]*IdleAcres*, *Cokato, MN*, [3]*Nutrena*, *Minnetonka, MN*.

Insulin resistance (IR), resulting in hyperinsulinemia, has been documented in young horses fed high starch/sugar feeds (NSC 20% or higher). Hyperinsulinemia has been reported to be correlated with an increased incidence of developmental orthopedic disease(DOD). To test the hypothesis that rations with low NSC (<20%) such as forage based total mixed ration (TMR) cubes or Safe Choice® (SF, Nutrena ®(Minnetonka, MN) may reduce IR in weanling horses, a series of three trials were conducted (2004-2006). Each year 12 weanlings were fed either TMR cubes (Next Generation, IdleAcres, Cokato, MN) free choice (TMR, n=6 per year) or Nutrena ®(Minnetonka, MN) Life Design ®Youth ® (HS:2004, 2005) or SF (LS:2006) to provide 50% of the calories recommended for growth with adlib grass/alfalfa hay (n=6 per year) for 6 weeks. Hay and cube orts were recorded. Horses were fed in individual stalls overnight and turned out in dry lot paddock 0830-1600h daily. Horses were visually monitored for epiphysitis and flexure deformities, rated in a scale of 0-4, and radiographs were taken if indicated. Insulin sensitivity was assessed with a low dose oral dextrose challenge (LDOD: 0.25 gm dextrose/kg BW) before treatments were initiated and after 6 weeks on treatments (PostTX). Glucose/insulin responses to equicaloric amounts of TMR and concentrates were measured PostTX in all years. Glucose/insulin data were compared within and between years by ANOVA for repeated measures factoring effects of treatment, individual and year where appropriate (Statistixs for Windows, Analytical software) and Students T-test where appropriate. Nutrient content of the rations differed between and within years (Table 1). No DOD>1 was observed in 2004. In 2005 two IR horses had DOD>2 before the treatments were initiated, one was placed on TMR, the other on HS. The one on TMR had a DOD score of <2 within 2 weeks of feeding, the one on HC had a score>2 throughout the study. In 2006 2 horses had DOD>2 but only one was IR. Bothe were fed TMR but had no change in DOD score. Glucose responses to the PostTX LDOD did not differ between treatments in the first two years but insulin responses tended (P<0.1) to be higher in HS fed horses, suggesting reduced insulin sensitivity. Glucose/insulin responses to HS were higher than TMR or LS. In 2006 TMR fed horses had higher (P<0.05) glucose and insulin responses those fed LS but both tended (P<0.1) to be lower than in previous years. Restriction of NSC may increase insulin sensitivity in weanling horses but will not prevent or resolve all DOD. Young horses with DOD are not always IR.

Table 1. Nutrient Content of Rations consumed (DM basis)

	HC04*	TMR04	HC05*	TMR05	HC06*	TMR06
Mcal/kg	2.4	2.2	2.2	2.2	2.6	2.4
%CP	14.0	18.7	11.0	16.7	14.7	15.6
%NSC	20.0	16.5	20.0	13.0	15.4	15.0

*based on total hay/concentrate consumed per day

Key Words: Horse, Insulin, Growth

62 Metabolic and digestive profiles of horses grazing spring pasture. B. McIntosh*[1,2], D. Kronfeld[1], R. Geor[1], W. Staniar[1], and P. Harris[3], [1]*Virginia Polytechnic Institute and State University*, *Blacksburg*, [2]*Blue Seal Feeds, Inc*, *Londonderry, NH*, [3]*WALTHAM Centre for Pet Nutrition*, *Melton Mowbray, United Kingdom*.

Laminitis often occurs in the spring and may be associated with dietary nonstructural carbohydrates (NSC). A 36 h study in April 2005 took examined the effects of forage NSC on grazing horses in Virginia. Fourteen mares were randomly assigned to grazing (housed on a 5-ha pasture predominantly tall fescue; n = 10) or control (stabled and fed timothy/alfalfa hay; n = 4) groups. The mares were 11±5 yr old, weighed 596.0±14.5 kg, and body condition scores ranged from 4.5 to 7.5 (on a scale of 1 to 9). Plasma glucose, insulin and L-lactate concentrations, and fecal pH and volatile fatty acids (VFA) were measured hourly. Hay samples and hourly pasture samples were analyzed (Dairy One, Ithaca, NY) for starch and sugar, where sugar is water soluble carbohydrates (and includes fructans), and NSC was the sum of starch and sugar. Data were tested for normality and repeated measures ANOVA with post tests were performed. The NSC content of the hay was 8.9±0.05 % DM, and pasture NSC content ranged from 15.8 to 25.3 % DM. Grazing horses had higher overall insulin and glucose than control horses (P < 0.05). Mean insulin concentrations in grazing horses displayed a circadian pattern that correlated to NSC levels in the forage (r = 0.60, P = 0.008). Plasma L-lactate was higher in grazing horses (0.64 mmol/L) than control horses (0.40 mmol/L) (P < 0.001). Fecal pH was lower in grazing horses (pH 6.9) than control horses (pH 7.2) (P = 0.008). Fecal VFA, including acetic acid, butyric acid, D- and L-lactic acid were higher in grazing horses compared to control horses (P < 0.05). The alterations in metabolic and digestive variables observed in grazing horses may reflect increased intake and digestion of hydrolysable and rapidly fermentable carbohydrates that were present in spring forages. Changes in carbohydrate metabolism and digestion in grazing horses during spring may increase risk of laminitis via exacerbation of insulin resistance and rapid fermentation in the hindgut.

Key Words: Horse, Forage, Laminitis

63 Fatty acid content of grass and legume hays commonly fed to horses. L. K. Warren* and J. Kivipelto, *University of Florida*, *Gainesville*.

Recent interest in supplementing equine diets with omega-3 (n-3) fatty acids (FA) for their potential anti-inflammatory benefits has generated the need to better characterize the FA composition of basal feeds. While flaxseed and marine-derived oils are potent sources of n-3 FA,

a limited amount of data suggest that forages may be a reasonable source of alpha-linolenic acid (C18:3). However, the FA composition of different forages is not well described. The objective of this study was to characterize the FA composition of several grass and legume hays commonly fed to horses. Different sources of each of the following 5 hays were examined: timothy (n=8), orchardgrass (n=6), Coastal bermudagrass (n=10), alfalfa (n=8) and perennial peanut (n=6). Hays were analyzed for FA composition, total fat, crude protein, NDF and ADF. Data were analyzed by ANOVA to compare differences between individual hay varieties, grass vs. legume hays and warm- vs. cool-season grass hays. Across all hays, C18:3 made up the greatest ($P<0.01$) portion of the total fat content of hay (39.1±1.9 g/100 g fat), followed by C16:0 (23.8±0.9 g/100 g fat) and C18:2 (21.2±0.9 g/100 g fat). Other FA detected in all hays included C18:0, 18:1, 20:0, 22:1 and 24:1, each ranging from 0.02 to 4.1 g/100 g fat. Grass hays tended to contain a higher ($P<0.10$) proportion of C18:0 than legume hays, but no other differences in FA content were detected between these hays. The total fat content of legume hays (6.9±0.6%) was higher ($P<0.05$) than that observed for grass hays (3.8±0.3%), suggesting that while the FA composition of legume hays does not differ greatly from grass hays, legume hays may provide a greater total quantity of C18:3. Warm-season grass hay tended to be higher ($P<0.10$) in C16:0 and C18:0 and lower ($P<0.10$) in C18:3 than cool-season grass hays. Individual grass hay varieties did not differ in total fat content. Across all hays, a negative correlation was found between C18:3 and ADF content ($r=-0.58$; $P<0.05$), which indicates n-3 FA content of hay may decline when forage is harvested for hay at a more mature stage. Ultimately, consumption of commonly available hays of good to moderate quality will result in a greater intake of n-3 FA (C18:3) over omega-6 FA, regardless of the type of hay.

Key Words: Omega-3 Fatty Acids, Alpha-Linolenic Acid, Forage

64 Effect of season, forage maturity and grazing on the fatty acid composition of bahiagrass pasture. L. K. Warren* and J. Kivipelto, *University of Florida*, *Gainesville*.

Although low in total fat, a limited amount of data suggest forage may serve as a significant source of alpha-linolenic acid (C18:3) in equine diets. However, the fatty acid (FA) composition of common pasture forages has not been widely described. The objectives of this study were to characterize the FA composition of bahiagrass pasture selected by grazing horses and to determine the effect of season and cumulative growth on pasture FA composition. Over a 24-mo period, 3 replicates of each of 3 types of pasture samples were obtained at 1-mo intervals: grasses on or near areas where there was recent evidence of grazing by horses (GRAZE), grasses obtained from the same plots each month (MONTH), and grasses obtained from different plots each month that were allowed to accumulate up to 12 mo of growth (ACCUM). Both MONTH and ACCUM samples were obtained from areas on pasture that were restricted from grazing. MONTH was used to assess change in FA composition for new growth occurring in each 1-mo interval. ACCUM was used to determine changes in FA content as pasture forage grew and matured. All samples were obtained from an 8.1-ha, mixed-cultivar bahiagrass (*Paspalum notatum*) pasture that continually housed the same 6 mature geldings. Differences in FA content between sample types and with season were determined by ANOVA. On average pasture contained 4.1±0.2% total fat. Across all months and sample types, C18:3 made up the largest proportion of the total fat in forage ($P<0.01$), followed by C16:0 ($P<0.01$) and C18:2 ($P<0.01$). Other FA detected in pasture included C17:0, 18:0, 18:1, 20:0, 22:1 and 24:1, each ranging from 0.1 to 5 g/100 g fat. On average C18:3 was higher ($P<0.01$) in GRAZE (56.4±2.2 g/100 g fat) and MONTH (54.7±2.3 g/100 g fat) than ACCUM (39.8±4.2 g/100 g fat), whereas C18:2 made up a greater ($P<0.01$) proportion of the fat in ACCUM (21.5±1.1 g/100 g fat) compared to GRAZE (15.2±0.6 g/100 g fat) and MONTH (16.8±0.6 g/100 g fat). Season ($P<0.05$) affected C18:3 and C18:2 content of MONTH and ACCUM samples, with higher levels observed from April to July. ACCUM samples contained higher ($P<0.01$) C17:0, 18:0, 18:1 and 20:0 than GRAZE and MONTH, indicating a rise in these FA as bahiagrass pasture matures.

Key Words: Alpha-linolenic acid, Omega-3 fatty acids, Warm-season forage

Immunology - Livestock and Poultry I

65 An initial evaluation of the pathogenesis of Turkey-origin avian reovirus in poults. C. Stephens*[1], M. Pantin-Jackwood[2], E. Spackman[2], and J. M. Day[2], [1]*University of Georgia*, *Athens*, [2]*Southeast Poultry Research Labs, USDA*, *Athens, GA*.

Enteric disease causes poor performance in turkey flocks and, consequently, production losses in the industry. The pathogenesis of enteric viruses is not well understood and needs to be studied to further understand the nature of enteric disease. A virus isolated in 2003 from the intestines of poorly performing commercial turkeys in North Carolina (NC/SEP-R44/03) was selected for this study. In a previous study, this virus induced both humoral and cell-mediated immunosuppression in two-day-old poults. Three-week-old Broad Breasted White turkeys were inoculated by oral gavage with NC/SEP-R44/03, and the sham inoculated birds were inoculated with sterile phosphate buffered saline. Both the sham inoculated birds and the infected birds were weighed at days 0, 9, and 16 days post inoculation (DPI) to evaluate body weights. At 8 and 15 days PI, ten sham birds and 10 inoculated birds were selected to study the cutaneous basophil hypersensitivity (CBH) response; a measure of cell-mediated immunity. Another 20 birds were selected to study the humoral immune response by evaluating their antibody titers to Newcastle disease vaccine. Serum was collected from these birds at 21 and 42 DPI, and the antibody titers were determined by ELISA and were compared between the sham inoculated birds and the virus inoculated birds. Poults were periodically necropsied and examined for clinical signs of enteric disease. The spleen, bursa, and thymus were collected for histopathological analysis. No clear differences between the treatment groups in bodyweight, CBH response, and antibody response were observed; however, gross lesions consistent with enteric disease were observed at 8 and 15 days PI. Gross lesions included gas-filled, fluid filled intestines with undigested feed, and ceca with frothy contents. Enlarged bursas of fabricius with bursal 'cores' were also observed. In conclusion, older turkeys, in contrast with younger turkeys, do not appear to suffer immunosuppression with reovirus; however, enteric disease is observed.

Key Words: Turkey, Reovirus, Pathogenesis

66 Characters and functions of anterior pituitary progenitor cells that are identified by a novel monoclonal antibody. Y. Nagai*, H. Aso, H. Ogasawara, S. Tanaka, K. Watanabe, S. Ohwada, and T. Yamaguchi, *Laboratory of Functional Morphology, Graduate School of Agricultural Science, Tohoku University*, *Sendai, Japan*.

In anterior pituitary gland, inflammatory mediators such as cytokines modulate the cell function through immuno-endocrine pathway. Our previous study showed that proinflammatory cytokine, IL-18 was localized in the cell layer of Rathke′s pouch that has been proposed to embody stem/progenitor cell compartment in the anterior pituitary gland of cattle. We established a stem/progenitor cell line (BAPC-1) from the anterior pituitary gland. BAPC-1 expressed the mRNA of stem/progenitor cell-associated factors and inflammatory cytokines including IL-1, IL-6, IL-8, IL-12 and IL-18. However, the nature and behavior of anterior pituitary progenitor cells remains unclear. The present study was conducted to produce monoclonal antibodies (mAbs) specific for the membrane protein of BAPC-1 and to detail anterior pituitary progenitor cells. It was revealed that the mAbs termed 12B strongly reacted with BAPC-1 and recognized 4Ig-B7-H3 molecule, which is a costimulatory molecule and a negative regulator in T-cell activation. The 12B-immunoreactive cells (12B-ir cells) were localized around the Rathke′s pouch in young and adult cows. However, the number of 12B-ir cells was less in adult cows compared with young cows. The 12B-ir cells were also observed around the pars tuberalis, which lie closely to median eminence and have blood supply via the primary portal plexus in anterior pituitary gland. In the intermediate lobe, 12B-ir cells were sporadically observed around the Rathke′s pouch in both cows. The 12B-ir cells corresponded with the cells immunoreactive for IL-18 around the Rathke′s pouch. Thus, 12B was available to detect anterior pituitary progenitor cells. These results suggest that anterior pituitary progenitor cells are localized in the layer of Rathke′s pouch and function as immunomodulatory cells.

Key Words: Anterior Pituitary, Stem/Progenitor, Immunomodulator

67 Effect of photoperiod on immune function in broiler chickens. S. Dalal*, K. Schwean-Lardner, B. Laarveld, H. L. Classen, and A. G. Van Kessel, *University of Saskatchewan*, *Saskatoon, SK, CANADA*.

Three experiments were conducted to investigate the effect of lighting program on immunity in broiler chickens. In experiment 1, 560 day-old male chicks were placed in 8 rooms (70 birds/pen) on used litter and assigned to 14, 17, 20 or 23 hours continuous light. Sixteen chickens were selected from one pen in each room and intraperitoneally administered 400 μg of lipopolysaccharide (LPS) in 1ml saline or saline every second day for 10 days beginning at day 17. Experiment 2 was a replicate experiment except that LPS or saline were administered beginning at 27 days of age. Weight gain during LPS administration and relative organ weight at the end of LPS administration were recorded. In experiment 3, 6264 day-old chickens were placed on fresh litter in one of 9 rooms at a housing density of 30 kg/m^2 and assigned to one of 3 lighting programs including intermittent (15h light: 3.5h dark: 2h light:3.5h dark), 17h light:7h dark (17L) and 23h light:1dark (23L). One bird was selected from each pen per room and administered (i.m.) on days 10 and 21 a commercial *E.coli* (K88) vaccine (0.2 mL/bird). On day 39, antibody titre was assayed in serum and heterophil phagocytic and free radical production was assayed in whole blood. LPS administration reduced ($P < 0.001$) weight gain in experiment 1 and increased ($P< 0.05$) relative liver and spleen weight in experiment 1 and 2. No interaction was found between lighting program and response to LPS. In Experiment 3, serum anti-K88 titre was highest ($P<0.05$) in birds on a 1 hour dark period compared with birds on other lighting treatments ($P<0.05$). Blood phagocytic activity was highest ($P<0.05$) in birds exposed to a 7 hour continuous dark period compared to an intermittent 7 hour dark period or a 1 h dark period. We conclude that lighting program did not markedly influence the magnitude of the inflammatory response to LPS. Short dark exposure appeared to support the highest serum antibody response, whereas a long continuous dark exposure supported the highest whole blood phagocytic activity.

Key Words: Lighting Program, Broiler, Immune Function

68 Gene expression profiling in heterophils from *Salmonella*-resistant and -susceptible chicken lines using a chicken 44K Agilent microarray. H. I. Chiang*[1], C. L. Swaggerty[2], M. H. Kogut[2], X. Y. Li[1], and H. Zhou[1], [1]*Texas A&M University*, *College Station*, [2]*United States Department of Agriculture*, *College Station, TX*.

Large-scale expression profiling is a promising tool for ascribing complex biological function and interactions between genes with available genomic sequence data. To determine the transcriptional response to *Salmonella* enterica serovar Enteritidis (SE) infection, a newly developed chicken 44K Agilent array was used to analyze RNA of heterophils from SE-resistant (line A) and SE-susceptible chickens (line B), treated with in vitro infection of SE (I) or non-SE medium (N). A dual-color balanced design was used to provide a direct comparison between SE-infected and non-infected groups (A-I vs. A-N, B-I vs. B-N) and between line A and line B (A-N vs. B-N, A-I vs. B-I). Each comparison includes four biological replicates with a dye swap. The medium signal intensity was normalized using locally weighted linear regression (LOWESS) method, and followed by a mixed model analyses using SAS program. The results indicated that: for the comparisons of SE infection with non-infection, 3096 genes in line A and 3312 genes in line B were differentially expressed ($P < 0.05$), while 67 and 56 genes were related to immune function, respectively. In the comparison of lineage (line A and line B) difference, 4377 genes in the non-infected and 4333 genes in the infected groups showed differential expression ($P < 0.05$), whereas 71 genes and 69 genes were immunologically related, respectively. Interestingly, more differentially expressed genes were identified in the comparison of the lineage difference than in the comparison of SE infected to non-infected group, however, there were more genes that achieved a 4-fold change (up- or down-regulated) in the latter comparison. The results discovered in the present study have laid a solid foundation to elucidate cellular and molecular mechanisms of SE infection in chickens.

Key Words: Chicken, Microarray, Salmonella

69 Relationship between growth performance and immuno-competence measurements in broiler strains under high ambient temperatures. M. M. Fathi*, A. Galal, S. A. El-Safty, and S. S. Al-Rishan, *Faculty of Agric., Ain Shams Univ.*, *Cairo, Egypt*.

An experiment was conducted to quantify the growth performance and immunological parameters of broiler strains under high ambient temperatures. Three different genetic strains of broiler chicks (125 Hubbard, 125 Ross and 125 Arbor Acres) were reared under similar managerial, environmental and hygienic conditions during summer

season of Egypt. The high and low ambient temperatures recorded during the experimental period were 33 and 28C, respectively. The birds were weighed weekly. Feed consumption and feed conversion ratio were determined on a week basis. At 4 weeks of age, 20 birds from each strain were randomly assigned to determine cell mediated response and relative weight of lymphoid organs. Also, at 5 weeks of age, 5 birds from each strain were randomly taken to determine the phagocytic ability. The results of the current study revealed that the Ross broiler chicks had significantly heavier body weight than that of Hubbard chicks. However, the Arbor Acres broiler chicks were intermediated. There were no significant differences among strains for feed consumption, feed conversion ratio and rectal temperature. With respect to cutaneous basophil hypersensitivity (CBH) response, it could be observed that the Hubbard strain had a greater dermal swelling response to phytohemagglutinin-P (PHA-P) followed by Ross one when compared to Arbor Acres strain at 72 hours post injection. Also, the Arbor Acres strain exhibited greater bursa and spleen (as a percentage of live body weight) compared to the remaining strains. On the other hand, the Ross strain showed smaller relative weight of thymus compared to the other strains. Concerning the phagocytic activity, the Ross strain had significantly lower level of carbon particles in their blood circulation as compared to Hubbard and Arbor Acres chicks. We concluded that although there was no significant difference for productive performance traits among strains, the Ross broiler chicks strain is hyper responder to phytohemagglutinin-P (PHA-P), had a better phagocytic ability and lower mortality rate compared to other strains.

Key Words: Broiler Strains, Immunocompetence, Growth Performance

70 The feather as an *in vivo* test tube for tissue immune responses. G. F. Erf*, B. Lockhart, K. Bateman, R. Finley, and O. T. Bowen, *University of Arkansas*, *Fayetteville*.

While the blood serves as an excellent window into humoral immune activity, it is much more difficult to monitor and assess qualitative and quantitative aspects of tissue immune responses. To determine the presence of cell-mediated immunity (CMI) to an antigen (Ag) *in vivo*, the Ag is injected into the wattle, wing-web or toe-web and the swelling response (SR) measured over a 12 to 72h period. However, the SR does not provide direct information on Ag-induced immune activities. Through our work on autoimmune loss of feather pigment cells (vitiligo) in Smyth line chickens, we have studied CMI extensively and noted that growing feathers, like other integumental tissues, are immunologically active sites. For our vitiligo studies we used growing feathers (5-10 mm living pulp) for histology, immunohistochemistry, cell isolation and gene-expression studies. Considering that the growing feather is a defined, accessible, living unit that can easily be removed for down-stream analyses, we examined the suitability of feathers for study of *in vivo* tissue immune responses. In Study 1, growing feathers of 12-wk-old roosters were injected with LPS, PHA, or vehicle. The feathers were collected 6h later. Histological examination revealed infiltration of heterophils, and heterophils, macrophages and lymphocytes, when LPS and PHA were injected, respectively. Vehicle injection was not associated with leukocyte infiltration. To test Ag-specific CMI, *Mycobacterium butyricum* was injected into feathers of *M. butyricum*-sensitized and -unsensitized chickens. Feathers were collected 4, 24, 48, and 72h later. Conventional histology and immunohistochemistry revealed leukocyte infiltration profiles in feathers identical to those reported previously for wattle tissue. Therefore, the feather is highly suitable for monitoring and assessing various aspects of CMI in an individual bird. Knowledge gained by studying tissue immune responses *in vivo* will find direct application in the design of vaccines and strategies to optimize immune system development and function.

Key Words: Cell-mediated Immunity, LPS, PHA

71 Risk factors for avian developmental immunotoxicity (DIT): potential role of sex, hormone status, and age. R. R. Dietert*, *Cornell University*, *Ithaca, NY*.

Recent research has suggested that the developing immune system is far more sensitive to environmental modulation than that of the fully-mature adult. Both quantitative differences in dose-response sensitivity as well as qualitative differences in the nature and extent of environmentally-induced immune alterations have been linked to the age of exposure. But a surprising observation is that age alone may not be the only risk factor warranting consideration. The sex of the embryo and hormone balance at the time of exposure may also help to determine subsequent immunotoxicity and as a result, later-life health risk. In fact, differential immunotoxic risk based on sex may be even greater in early life than in the adult. Even in cases where there is not necessarily a dose-sensitivity difference between the sexes, the nature of immunotoxic alterations may differ among the sexes. Hormone alteration at the time of exposure seems to influence risk even when the toxicant is not a potent endocrine-disruptor. Additionally, immune impairment may not be readily apparent until post-hatch stress and/or disease challenges occur. As a result, unpredicted post-hatch immune responses, particularly when they are restricted to a subpopulation, may not be readily identified in term of early-life cause/later-life effect. For this reason, it is important to recognize the potential for differential sex-determined and hormone-influenced immunomodulatory responses following both intended (vaccine and/or adjuvant exposures in poultry) and unintended in ovo exposure. This presentation will review recent results in birds concerning heavy metals, and other toxicants relative to early life-insult and subsequent immunotoxic risk. Supported by USDA Grant Regional Project NE-1016.

Key Words: Developmental Immunotoxicity (DIT), Avian, Risk Factors

72 Antibody response against bovine red blood cells in major histocompatibility (*B*) complex recombinant *R13*. N. G. Wilkinson[1], L. M. Yates[2], R. T. Kopulos[2], W. E. Briles[2], and R. L. Taylor, Jr.*[1], [1]*University of New Hampshire*, *Durham*, [2]*Northern Illinois University*, *DeKalb*.

Recombination within the chicken major histocompatibility complex (MHC) has enabled more precise identification of genes controlling immune responses. Chicken MHC genes that are closely linked on chromosome 16 include *B-F*, MHC class I; *B-L*, MHC class II; and *B-G*, MHC class IV. Six congenic lines, each containing a single unique MHC recombinant, achieved 99.9% genetic uniformity through ten backcross generations to inbred Line UCD 003 genotype *B17B17*. Recombinant *R13* (*BF17-BG23*), arose in a single male from the tenth backcross generation for *R1* (*BF24-BG23*). An additional backcross to the Line UCD 003 background increased the number of *R13*

individuals. This new recombinant was tested for antibody production against the T-dependent antigen, bovine RBC (BRBC). Fifty-one progeny segregating for *R13R13* (n = 10), *R13B17* (n = 26), and *B17B17* (n = 15) genotypes were produced by a single *R13B17* male mated to five *R13B17* dams. One mL of 2.5% bovine BRBC was injected intravenously into all genotypes at 4 and 11 weeks of age to stimulate primary and secondary immune responses, respectively. Blood samples were collected 7 days post-injection. Serum total and mercaptoethanol (ME)-resistant antibodies against BRBC were measured by microtiter methods. Titers were expressed as the $\log_2$ of the reciprocal of the highest dilution giving visible agglutination. The least squares ANOVA used to evaluate all primary and secondary antibody titers included hatch and *B* genotype as main effects. Significant means were separated by Fisher's Protected LSD at $P < 0.05$. *R13R13* chickens had significantly lower primary total and ME-resistant antibodies than did the *R13B17* and *B17B17* genotypes. Secondary total and ME-resistant antibodies were significantly lower in *R13R13* chickens compared with *R13B17* but not *B17B17* chickens. Gene differences generated through recombination impacted the antibody response of *R13* compared with *B17*. Secondary antibody titers were not substantially higher than the primary titers suggesting that the memory response had waned in the 7 week interval between injections.

Key Words: Immunity, Recombination, Antibody

Graduate Student Paper Competition: National ADSA Dairy Foods Division

73 Use of HTST pasteurization combined with other nonthermal processes to improve fluid milk shelf life. Z. P. Caplan* and D. M. Barbano, *Cornell University*, *Ithaca, NY*.

Our objective was to develop a process using minimum HTST pasteurization in combination with other nonthermal processes to achieve 60 to 90 days of fluid milk shelf life at 6°C. Microfiltration of raw skim milk and different methods of reducing the total bacteria count of milk fat sources for production of 2% milk were evaluated. Microfiltration (MF) and HTST pasteurization were used to reduce total bacteria, spores, and coliforms in 2% milk made from MF skim milk and various milk fat sources. Raw skim milk was microfiltered at 51°C using a Tetra Alcross M7 Pilot Plant equipped with a ceramic Membralox membrane (pore size: 1.4 micron). MF skim milk plus 3 different milk fat sources were heated to 51°C, and pumped, by weight, into separate containers of MF skim milk to create different 2% milks. These milks were compared to a MF skim milk control without fat added. Each 2% milk was homogenized at 500/2500 psi before undergoing HTST processing (73°C, 15 sec). Total bacteria counts of raw and pasteurized MF skim milks, and pasteurized 2% milks, were determined with most probable number and standard plate count (SPC) methods. Average (n=4) raw skim milk SPC was reduced from 1690 cfu/mL to 0.13 cfu/mL by MF, and further reduced to 0.08 cfu/mL by HTST processing, demonstrating an average 4.3 log reduction from the raw skim milk count due to the combination of MF and HTST. The SPC for all of the pasteurized 2% milks averaged <100 cfu/mL. The pasteurized MF skim milk and pasteurized 2% milks were then stored at 6°C, and the SPC was determined weekly over a 90 d period using a Foss Bactoscan™ FC. Different fat sources did not have a large impact on shelf life. Across 3 replicates, 9 of 9 one liter containers of the pasteurized MF skim milk, and 23 of 27 one liter containers of the pasteurized 2% milks, remained below 20,000 cfu/mL at 70 d. Minimum HTST pasteurization combined with other nonthermal processes was used to successfully extend refrigerated fluid milk shelf life beyond 60 d at 6°C.

Key Words: Microfiltration, Shelf Life, HTST

74 Manufacture of pasteurized process cheese spread from milk concentrated by microfiltration. H. Somni*, V. V. Mistry, K. Muthukumarappan, and K. R. Nauth, *Midwest Dairy Foods Research Center, South Dakota State University*, *Brookings*.

The objective was to replace base cheese in pasteurized process cheese (PC) spread making with microfiltered (MF) milk. Earlier studies focused on PC manufacture from ultrafiltered (UF) milk. With microfiltration, milk proteins are fractionated and offer unique opportunities in process cheese making. Raw skim milk was microfiltered using 0.1µm membrane to approximately 5.7X casein concentration (MFC). Casein in the MFC was 95, 94 and 77% of true protein, total protein and total solids, respectively. MFC was used to substitute base Swiss cheese in PC spread formulations at 33% (T1), 66% (T2) and 100% (T3) by weight of cheese. Total solids, fat, and salt were targeted to 59, 21.5, and 1.5%, respectively, and pH at 5.75. Control (C) was made from Swiss cheese without any substitution. Swiss cheese flavor concentrate was added at 0, 0, 1.85 and 3.5 % levels to C, T1, T2 and T3, respectively. The cheese spread was pasteurized at 71°C for 2 min. The treatments were replicated three times using a randomized block design. Cheeses were analyzed for composition, sensory and rheological properties. Spreadability was measured as percent increase in area after 2.5 and 5.0 min at 25°C. Means were compared using PROC GLM procedure of SAS at p=0.05. With increase in the level of MFC in the spreads, total protein decreased and minerals increased significantly. Control differed from treatments and had minimum viscosity. The bulk and elastic moduli differed for the treatments but did not correlate to level of MFC. A panel of seven expert judges rated T1 above C and the difference was significant for overall flavor, body and texture, and overall acceptability on 1-9 scale (9-liked most and 1-extreme dislike). Substitution of base Swiss cheese with MFC significantly affected rheological properties of the PC spread. This could be because of differences in the protein and minerals levels within the treatments. Thus, microfiltration offers opportunities for developing spreads with consistency and acceptable quality.

Key Words: Microfiltration, Process Cheese Spread

75 Effect of different stabilizers on the textural and rheological properties of cream cheese. M. Brighenti*[1], S. Govindasamy-Lucey[2], J. J. Jaeggi[2], M. E. Johnson[2], and J. A. Lucey[1], [1]*University of Wisconsin*, *Madison*, [2]*Wisconsin Center for Dairy Research*, *Madison, WI*.

Stabilizers are added during cream cheese manufacture to help prevent syneresis during storage. The objective of this study was to determine the impact of different stabilizers on the texture and rheology of cream

cheese. Cream cheeses were manufactured with 0.33% of xanthan gum, locust bean gum or guar gum, and a combination (CBN) of these three stabilizers (0.11% of each). The rheological properties of solutions of these gums, under conditions similar to the aqueous phase of cream cheese (0.6% gum, 1.8% NaCl and pH 5.00), were also tested. Dynamic small amplitude rheological properties were measured during heating from 5 to 80°C at 1°C/min and cooling at the same rate and the parameters measured were storage modulus (SM) and loss tangent (LT). Hardness was determined by texture profile analysis (TPA). A trained sensory panel used spectrum descriptive analysis to determine firmness, stickiness, and spreadability. Lower LT values (indicating higher elasticity) were observed in several regions of the heating and cooling curves for the CBN cream cheeses compared to the cream cheeses manufactured with the individual gums. The CBN cream cheeses gave significantly ($P<0.01$) higher hardness values than the cream cheeses manufactured with the individual gums. A similar trend was observed for firmness and spreadability obtained from sensory analyses while stickiness gave the opposite trend. Due to small differences in the moisture contents of the experimental cream cheeses further replicates will be performed. Rheological tests on the CBN solutions also indicated that they had higher SM values than the individual gums. Differences were also observed among the solutions containing individual gums with locust bean gum solutions having the lowest SM followed by guar gum and xanthan. The higher hardness and lower LT values observed for the CBN cheese samples could be due to the synergistic interaction that exists between xanthan and the galactomannans present in guar gum and locust bean gum. This study shows that the stabilizers used in cream cheese manufacture impacted the texture and rheology of cream cheese.

Key Words: Texture, Cream Cheese, Stabilizers

76 Effect of stabilizers on fat agglomeration and melting resistance of ice cream. I. Herlambang*[1], W. J. Harper[1], and B. W. Tharp[2], [1]*The Ohio State University*, *Columbus*, [2]*Tharp's Food Technology*, *Wayne, PA*.

Hydrocolloid stabilizers are commonly used in ice cream to improve smoothness of body, increase melting resistance and maintain stability during storage. Fat network is one essential element in development of ice cream infrastructure. The mechanism in which the stabilizers affect the fat agglomeration is not yet well understood.

The first objective of this study was to examine the particle size distribution and melting properties of ice creams varying in emulsifiers and gums. Eight commercial ice creams were analyzed for particle size and melting properties. Another objective of the study was to understand the effect of carboxymethyl cellulose (CMC) on fat agglomeration during freezing in the presence and absence of an emulsifier. Ice cream mix was formulated to contain 10% milk fat, 10% milk solids-not-fat, 12% sucrose, 6% corn syrup solids, and 0.15% CMC. The formulations also included mixes with and without 0.15% mono-and di-glycerides (MDG). Fat aggregation was indicated by D[4.3] and % particles above 10 µm as measured by a Malvern Mastersizer. Melting rate was defined as the amount of drip loss divided by melting time. The commercial ice cream analysis showed that ice cream with egg yolks (EY) without any stabilizers had no fat aggregates. Particle size distributions varied between ice cream brands. Ice creams with MDG or those with gums in addition to EY showed an increased aggregation. Ice cream without stabilizer, which also had no fat aggregates, melted at the fastest rate. Gums decreased the melting rate and the melting properties were independent from particle size. Ice cream with only CMC showed the highest amount of fat aggregates and highest resistance to melting. The effect was followed by ice cream made with both CMC and MDG, and only MDG. The amount of fat aggregates was highly correlated to the melting resistance of the ice creams. Ice cream with most melting resistance had greater amount of fat aggregates. The results indicated that stabilizers in ice cream affected fat agglomeration by somewhat modifying the fat structure. These results are useful to better understand the functionality of stabilizers in ice cream.

Key Words: Fat Agglomeration, Stabilizers, Ice Cream

77 Optical measurement of curd shrinkage during cheese manufacturing. C. C. Fagan*[2,1], M Castillo[1], C. P. O'Donnell[2], D. J. O'Callaghan[3], and F A Payne[1], [1]*University of Kentucky*, *Lexington*, [2]*University College Dublin*, *Ireland*, [3]*Moorepark, Teagasc*, *Cork, Ireland*.

There is currently a drive towards continuous monitoring and automation in the cheese processing industry. Control of the process through real time analysis of critical quality parameters can improve product quality and consistency. Full automation of the manufacturing process is dependent on developing technologies for monitoring critical unit operations such as syneresis. The objective of this study was to determine if the response of an optical sensor detecting light backscatter in a laboratory scale cheese vat was related to physicochemical changes occurring in the curd and whey mixture during syneresis. A three-factor (coagulation temperature, calcium chloride addition level, cutting time), randomized, central composite design comprising 20 runs was carried out in triplicate. A prototype sensor collected scattered light during coagulation and syneresis which was conducted through a fibre optic cable to a miniature spectrometer. Upon cutting the gel, stirring commenced and samples of curd and whey were removed at 10 min intervals up to 85 min after cutting and analyzed for moisture and fat. The sensor output during syneresis at each sampling point was shown to have a significant relationship with curd moisture and whey fat content ($P < 0.001$). The rate of change of the optical sensor response was also significantly ($P < 0.01$) correlated with the kinetic rate constants for changes in curd moisture and whey fat content during syneresis. In conclusion, these results showed that light backscatter measured during syneresis was sensitive to physicochemical changes resulting from curd shrinkage and provided information required for curd moisture content control. This optical technique has the potential to be developed as a unique sensor for monitoring syneresis, providing a key enabling technology for improving process control during cheese manufacture.

Key Words: Light Backscatter, Syneresis, Curd Shrinkage

78 Impact of different curd-washing methods on the insoluble Ca content and rheological properties of Colby cheese. M.-R. Lee*[1], M. E. Johnson[2], S. Govindasamy-Lucey[2], J. Jaeggi[2], and J. A. Lucey[1], [1]*University of Wisconsin*, *Madison*, [2]*Center for Dairy Research*, *Madison, WI*.

A curd-washing step is used in the manufacture of some cheese varieties (e.g. Colby) to decrease the residual lactose content and to reduce the formation of lactic acid during ripening. Curd washing

may also alter the levels of Ca, which may influence cheese rheology. The objective of this study was to investigate the impact of different washing methods on the Ca equilibrium and rheological properties of Colby cheese. Four different methods of curd-washing were performed including batch washing (BW) where water (10°C) was added to the vat, with and without stirring, where curds were in contact with water for 5 min. The other method used was continuous washing (CW), with or without stirring, where curds were rinsed with continuously running water for ~15 min and water was allowed to drain immediately. The rate of acid development during manufacturing was similar in all 4 treatments. The insoluble (INSOL) Ca content of cheese was measured by cheese juice method and rheological properties were measured by small amplitude oscillatory rheology. The levels of lactose in cheese at 1 d were significantly ($P<0.05$) higher in both CW cheeses (0.08%) than in both BW cheeses (0.02%). The levels of lactic acid at 2 and 12 wk were significantly ($P<0.05$) higher in both types of CW cheese compared with both BW cheeses. The INSOL Ca content of all cheeses decreased during the first 4 wk and this occurred concomitantly with an increase in cheese pH from 5.1 to 5.4. The INSOL Ca content of cheese during ripening was significantly ($P<0.01$) affected by washing method but not by stirring. The INSOL Ca content of BW cheeses was significantly higher ($P<0.05$) than that of CW cheeses at all time points during the first mo. At 1 d and 1 wk of ripening the maximum loss tangent values during heating of cheese were significantly higher ($P<0.05$) in CW cheeses compared to BW cheeses. In conclusion, different curd washing methods had a significant impact on the levels of lactose, lactic acid, INSOL Ca and meltability of Colby-type cheese during ripening.

Key Words: INSOL Ca, Curd Washing, Cheese Meltability

79 Preference mapping of commercial strawberry drinkable yogurt among African-American, Caucasian and Hispanic consumers. J. L. Thompson*, K. Lopetcharat, and M. A. Drake, *North Carolina State University*, *Raleigh*.

The drinkable yogurt marketplace is a competitive and growing category in the dairy industry. Drinkable yogurts vary widely in flavor, variety, texture, and other sensory properties. Understanding these sensory differences is critical for understanding the product and ultimately consumer preference. Little is known about differences in preference among Caucasian, African-American, and Hispanic consumers within the United States. The objective of this study was to identify and define the sensory characteristics of commercial drinkable yogurts and identify consumer preferences among Caucasian, African-American, and Hispanic consumers in the United States. Focus groups with each ethnic group (3 groups/ethnicity) were conducted to gain insight into perceptions of drinkable yogurts. A descriptive sensory language was developed to document the sensory properties (visual, flavor, and mouthfeel) of strawberry drinkable yogurts. Thirteen commercial products (strawberry flavor) were evaluated by a trained panel using the sensory language. Five representative yogurts were chosen for consumer testing by African-American (n=83), Caucasian (n=88) and Hispanic (n=88) consumers. Univariate and multivariate analyses were conducted to identify differences in product liking among the consumer groups. Drinkable yogurts were differentiated by descriptive analysis in visual, flavor and mouthfeel attributes ($p<0.001$). Three distinct clusters of consumers were identified and ethnic membership within the clusters was distinct ($p<0.05$). Key drivers for all three consumer clusters were natural fruit flavor and sweet taste. The impact of changes in these attributes on liking differentiated two of the three consumer clusters while the third consumer cluster was characterized by these attributes along with other fruit flavors, artificial sweetener, and color intensity as key drivers. Acceptability varied widely among consumers and consumer ethnicities and drinkable yogurts with specific flavor and physical properties could be marketed to specific target market segments.

Key Words: Drinkable Yogurts, Preference Mapping, Sensory Analysis

80 Classification of cheddar cheese based on flavor quality using Fourier transform infrared spectroscopy. A. Subramanian*, J.W. Harper, and L.E. Rodriguez-Saona, *The Ohio State University*, *Columbus*.

Flavor quality of cheddar cheese significantly influences its acceptance and price. Cheese flavor is directly affected by the changes that occur during maturation. Cheese flavor is currently determined using trained sensory panels. This process is time consuming and very expensive. Hence there is a need for rapid and simple instrumental methods. Fourier transform Infrared (FT-IR) spectroscopy, which monitors the light absorbing properties of chemical compounds, combined with an efficient sample preparation method, can be used as a rapid, inexpensive, and sensitive method to analyze cheese flavor. The objective of this research was to develop a sample preparation method and FT-IR technique to rapidly predict flavor quality of cheddar cheese. Fifteen cheddar cheese samples obtained from a local manufacturer were ground into powders using liquid nitrogen. The water-soluble compounds from the cheese powder, without interfering compounds such as fat and protein, were extracted using water and organic solvents. Aliquots (10 μL) of the extract were placed onto a FT-IR sample crystal, dried and scanned in the spectrometer (4000 to 700 cm^{-1}). The spectra were matched with the flavor quality to build multivariate classification models. The developed extraction method yielded extracts, whose FT-IR spectra were highly consistent within each sample and distinct from other samples. The multivariate model showed a 3D plot in which all the 15 cheese samples formed well separated clusters. The orientation of the clusters in 3D space correlated well with the cheese flavor. All the cheese samples could be classified based on their flavor quality attributes (fermented, unclean, low flavor, sour, good cheddar, etc.). The discrimination of the samples was due to organic and fatty acids and their esters (1500 to 900 cm^{-1}), which are known to contribute significantly to cheese flavor. The total analysis time, including the sample preparation time, was less than 20 min per cheese sample. This technique can be a rapid, inexpensive, high-throughput and simple tool to the cheese industry for predicting the flavor quality of cheese.

Key Words: Cheddar Cheese, Flavor, Infrared Spectroscopy

81 Perfusing egg yolk antibodies in enterotoxigenic *Escherichia coli* K88 infected piglet jejunal segments reduces fluid and electrolyte losses. E. Kiarie*, B. A. Slominski, D. O. Krause, and C. M. Nyachoti, *University of Manitoba*, *Winnipeg, MB, Canada*.

Effects of anti-K88 egg yolk antibodies (EYA) on fluid and electrolyte losses were studied using an *in situ* model of secretory diarrhea in which jejunal segments of 4 anaesthetized piglets were infected with enterotoxigenic *E. coli* K88 (ETEC) and perfused with either EYA or conventional anti-diarrhea agents carbadox (C), zinc oxide (ZO) and fumaric acid (FA). Pigs were weaned at 21 d of age and fed a commercial starter diet for 7 d. In each pig, the first segment (20 cm) was prepared at 300 cm caudal from the stomach and fitted with inflow and outflow PVC tubing at cranial and caudal sites, respectively. Caudal from and adjacent to the first segment 9 other segments were similarly prepared to give a total of 10 segments per pig. Treatments in deionized water suspension were: FA (20 mg/l), ZO (3 g/l), C (55 mg/l), EYA (5 g/l), with saline (S) as a control. In each piglet, a pair of segments (1 non-infected and the other ETEC-infected) were perfused simultaneously with 60 mL of each treatment at 4 mL for every 30 min for a total of 7.5 h. Outflow contents were collected; 2h after the last perfusion, solutions remaining in the segments were emptied into respective containers and then the pig was killed. Net fluid and electrolyte absorption were calculated from the difference between the volume and concentration of inflow and outflow divided by the surface area of each segment. Net loss was calculated as the difference between net absorption in non-infected and infected segments. ETEC infection reduced ($P < 0.05$) fluid absorption in S perfused segments (105 ± 12 µl/cm^2) compared with segments perfused with EYA (760 ± 64 µl/cm^2) C (605 ± 53 µl/cm^2), ZO (624 ± 61 µl/cm^2) and FA (298 ± 34 µl/cm^2). High ($P < 0.05$) Na and Cl losses were observed in ETEC-infected segments perfused with S, FA and ZO compared with those perfused with EYA and C. In conclusion, EYA enhanced fluid absorption and protected against electrolyte losses in piglets challenged with ETEC.

Key Words: Egg Yolk Antibodies, Enterotoxigenic *E. coli*, Piglet

82 Dietary addition of mannobiose, beta glucan, or mannan-oligosaccharides on growth performance and immune response in early-weaned pigs raised at two locations. Y. Han*[1], J. J. Brennan[1], and M. Vignola[2], [1]*Maple Leaf Foods Agresearch*, *Guelph, Ontario, Canada*, [2]*Maple Leaf Foods Agresearch*, *St-Romuald, Quebec, Canada*.

A two-location trial was conducted in early-weaned pigs to study the influence of dietary mannobiose, yeast beta glucan, or mannan-oligosaccharides (MOS) on growth performance and response to *Mycoplasma hyopneumoniae* (MH) vaccine. A total of 960 17 to 21-d-old piglets were used in a complete randomized block design with 192 (8 blocks of 4 pens, 6 pigs/pen) and 768 (12 blocks of 4 pens, 16 pigs/pen) in Ontario and Quebec, respectively. After weaning, pigs were immediately given the experimental diets for 21 d following three-phase feeding programs. At the Ontario location, a MH vaccine was administered at weaning. Throughout Phase 1-3 the basal medicated diet was supplemented with 40ppm mannobiose, 60ppm yeast beta glucan, or 2000ppm MOS. The trial duration was 40 and 42 days for Ontario and Quebec locations, respectively. On d 21 and 35, blood samples were taken from the Ontario pigs for determination of serum MH antibody titres. Main and interactive effects of Diet, Location and Block were analyzed by ANOVA with Block nested within Location and weaning BW as a covariate. Dietary mannobiose significantly improved cumulative feed efficiency by 2.5% by Week 3 ($P<0.033$), 1.6% by Week 5 ($P<0.044$), and 1.6% by end of the experiment ($P<0.033$). None of the additives improved growth ($P>0.05$). Beta-glucan increased MH vaccine antibody titres in pigs in comparison to those fed MOS. It was concluded that mannobiose was a cost-effective feed additive in medicated starter pig diets and that its effect persisted post-withdrawal. The immunostimulatory effect of yeast beta glucan did not impact animal performance.

Key Words: Early-Weaned Pigs, Mannobiose, Growth Performance

83 Evaluation of plant materials for alternative adhesion of *E. coli* K88 (ETEC) in weaning pigs. R. Maiorano*[1,2], A. W. Jongbloed[1], C. M. F. Wagenaars[1], P. G. Van Wikselaar[1], and P. M. Becker[1], [1]*Animal Sciences Group*, *Lelystad, The Netherlands*, [2]*University of Milan*, *Milan, Italy*.

Specific carbohydrates in some plant materials can function as alternative adhesion matrices for e.g. *E. coli* K88 (ETEC). *In vitro* studies in our lab revealed the efficacy of several plant materials with respect to their binding capacity of various pathogenic GI bacteria. We validated the *in vitro* studies by evaluating the effect of 4 additives, yeast product (Tr II), SW7 (Tr III), SW11 (Tr IV) and sesame seed expeller (Tr V) compared to a negative control (Tr I), on *E. coli* K88 faecal shedding of post-weaning piglets challenged with *E. coli* K88. Pigs (n=72) weaned at 28 to 35 d of age with an initial BW of 7.0 ± 0.18 kg were individually allocated in 72 pens. On d 7 after the weaning, the piglets were orally infected twice with a suspension of 5×10^9 cfu/ml *E. coli* 0149K91$^+$K88ac. Individual BW was noted on the weaning day (d 1), d 6, 13, and on d 22. Feed intake (FI) and faecal consistency scores (FCS) were registered daily. Faecal samples were collected from all the pigs for 8 consecutive days after the challenge to quantify ETEC. There was a depression in FI on d 9 and 10 with all treatments. This drop was largest with treatment I and smallest with treatments II, IV and V. At d 3 post-inoculation, groups II and V showed a significantly lower concentration of faecal *E. coli* K88 compared to group I and IV ($P< 0.03$). From d 4 to d 6 after the inoculation, treatments II and V significantly reduced the *E. coli* faecal count compared to groups I, III and IV ($P<0.05$). From d 6 to 12, group II revealed a significantly better FCS than groups I and IV. These results show clear evidence of the efficacy of the yeast product, sesame seed expeller and to a lesser extent SW 7 to decrease *E. coli* K88 faecal shedding. *In vitro* predictions about the efficacy of different plant materials in inhibiting *E. coli* K88 proliferation were confirmed by the *in vivo* trial.

Key Words: Plant Materials, *E. coli* K88, Piglet

84 Effect of fermentable carbohydrates on the intestinal microbial ecosystem in growing pigs fed low-P diets. B. U. Metzler*[1], W. Vahjen[2], T. Baumgärtel[3], M. Rodehutscord[3], and R. Mosenthin[1], [1]*Institute of Animal Nutrition, University of Hohenheim*, *Stuttgart, Germany*, [2]*Institute of Animal Nutrition, Free University of Berlin*, *Berlin, Germany*, [3]*Institute of Agricultural and Nutritional*

Sciences, Martin-Luther-University Halle-Wittenberg, *Halle (Saale), Germany*.

To determine the effects of differently fermentable carbohydrates on species composition and diversity of intestinal bacteria in pigs, 8 barrows (mean BW 35.9±0.9 kg), fitted with a simple-T-cannula at the distal ileum, were used in a double incomplete 4x3 Latin square design with 4 diets and 3 periods. Dietary treatments consisted of a low-P corn-soybean meal-based control diet or 75% of the control diet and 25% of cellulose, starch and pectin, respectively. After 15d adaptation to the experimental diets, rectal samples of feces were taken during 5d for bacterial DNA determination. Afterwards, ileal digesta were collected for bacterial DNA determination over two periods of 12h each. Quantitative realtime PCR and denaturing gradient gel electrophoresis (DGGE) was applied to specify total bacterial populations both in ileal digesta and feces as well as bacterial diversity and populations of specific bacterial groups in the ileum. Total ileal and fecal bacterial populations were not affected by dietary treatment but there were specific changes in the composition of the ileal microflora. Starch stimulated the population of lactobacilli ($P<0.05$), while cellulose stimulated the growth of bifidobacteria ($P<0.05$) compared to the control. Pectin tended to promote the growth of Bacteroides-like bacteria ($P<0.1$). The bacterial diversity at the distal ileum was affected by the carbohydrates as indicated by the different DGGE band numbers ($P<0.05$). Cellulose and starch inclusion caused a higher bacterial diversity, while pectin reduced it ($P<0.05$) compared to the control. These data suggest that the ileal microbiota is sensible to changes in the carbohydrate composition of the diet which is reflected in changes in the microbial community and diversity at the distal ileum.

Key Words: Fermentable Carbohydrates, Bacteria, Pigs

85 Effect of lactoferrin on the growth performance, intestinal morphology, immune function and serum iron level of weaned piglets. Y. Z. Wang*, T. Z. Shan, J. X. Liu, and Z. R. Xu, *Zhejiang University*, *Hangzhou, Zhejiang, China*.

A total of 90 weanling female pigs (Duroc×Landrace×Yorkshire) were used in a 30-d growth experiment to investigate the effect of lactoferrin on growth performance, intestinal microflora and intestinal morphology, immune functions and serum iron levels. The pigs were allocated on the basis of BW and litter to 3 dietary treatments in a randomized complete block design. The dietary treatments were: control group (basal diet), antibiotics group (basal diet + 20 mg/kg flavomycin +110 mg/kg aureomycin) and lactoferrin group (basal diet + 1.0 g/kg lactoferrin). There were 3 replicate pens per treatment and pigs were grouped with 10 pigs per pen. Six pigs, randomly selected from each treatment (2 pigs/pen) were slaughtered for serum and spleen samples on d 30. The results showed that supplementation with lactoferrin significantly increased the ADG by 34.04% ($P<0.01$) and decreased feed efficiency (F/G) by 12.83% ($P < 0.05$), increased the villus height ($P<0.01$) and lowered crypt depth ($P<0.05$) at the small intestinal mucosa as compared with the control. Supplementation with lactoferrin improved the PHA stimulated peripheral lymphocyte proliferation by 47.19% ($P<0.01$), increased both ConA and PHA-induced spleen lymphocyte proliferation by 116.90% ($P<0.01$) and 89.08% ($P<0.01$), enhanced the serum IgG by 10.99% ($P<0.05$), IgA by 20.00% ($P<0.05$) and IgM by 12.64% ($P<0.05$), IL-2 by 46.64% ($P<0.01$) and serum iron values by 25.79% ($P<0.05$) respectively. Compared with the antibiotic group, supplemental LF also improved PHA stimulated peripheral lymphocyte proliferation by 19.30% ($P<0.05$), increased both ConA and PHA-induced spleen lymphocyte proliferation by 68.23% ($P<0.051$) and 61.10% ($P<0.05$), enhanced the serum IgM by 11.36% ($P<0.05$), IL-2 by 36.26% ($P<0.05$). These results support the possible use lactoferrin as an immunostimulant to improve immune functions and strengthen host defenses would be a good method for defending weanling piglets from infections and weanling stress.

Key Words: Lactoferrin, Weanling Piglet, Growth Performance

86 Effects of adding saturated fat to diets with sorghum-based distillers dried grains with solubles on growth performance and carcass characteristics in finishing pigs. C. Feoli*[1], S. Issa[1], J. D. Hancock[1], T. L. Gugle[1], S. D. Carter[2], and N. A. Cole[3], [1]*Kansas State University*, *Manhattan*, [2]*Oklahoma State University*, *Stillwater*, [3]*USDA/ARS*, *Bushland, TX*.

A total of 112 barrows (avg BW of 72 kg) was used in a 65-d growth assay to determine the effects of adding a source of saturated fat (beef tallow) into diets with sorghum-based distillers dried grains with solubles (DDGS). The pigs were sorted by ancestry and blocked by BW with seven pigs/pen and four pens/treatment. Treatments were a corn-soybean meal-based control and diets having 40% DDGS (US Energy Partners, Russell, KS) with none, 2.5, and 5% added tallow. Feed and water were consumed on an ad libitum basis until the pigs were slaughtered (avg BW of 130 kg) to allow collection of carcass data and jowl samples. Fatty acid composition of the jowl samples was used to calculate iodine value (IV) as an indicator of carcass firmness. The corn-soy control supported greater ADG ($P < 0.03$) and ADFI ($P < 0.001$) with no difference in G:F ($P > 0.32$) compared to the DDGS treatments. Increasing fat additions from none to 5% in diets with DDGS did not affect ADG ($P > 0.69$) but improved G:F (linear effect, $P < 0.02$) by 10%. Hot carcass weight (linear increase, $P < 0.05$), dressing percentage (linear increase, $P < 0.06$), and last rib backfat thickness (linear decrease, $P < 0.04$) responded positively as fat addition to the diets was increased from none to 5%. However, changes in IV suggested deposition of softer fat in pigs fed DDGS ($P < 0.001$) even when saturated fat was added to the diet. For the control, DDGS + no tallow, DDGS + 2.5% tallow, and DDGS + 5% tallow, ADG was 961, 885, 877, and 894 g/d, ADFI was 3.3, 3.2, 2.9, and 2.9 kg/d, G:F was 291, 277, 302, and 308 g/kg, hot carcass weight was 93, 90, 91, and 92 kg, dressing percentage was 71, 69, 69, and 71%, last rib backfat thickness was 19, 20, 18, and 18 mm, and IV was 68, 72, 73, and 74, respectively. Adding beef tallow to diets with DDGS improved efficiency of growth and several carcass measurements but resulted in less saturated carcass fat.

Key Words: Distillers Dried Grains, Iodine Value, Pig

87 Effect of feeding fermented soybean meal on plasma concentration of cortisol in LPS-challenged nursery pigs. D. A. Monson*[1], J. A. Carroll[2], R. D. Mateo[1], and S. W. Kim[1], [1]*Texas Tech University*, *Lubbock*, [2]*USDA-ARS-Livestock Lissues Research Unit*, *Lubbock, TX, USA*.

The objective of the present study was to determine if feeding nursery pigs diets containing either plasma protein (PP) or fermented soybean meal (FSBM) would alter the overall stress response to a lipopolysaccharide (LPS) challenge as indicated by plasma concentrations of

cortisol. Pigs (n=24) were weaned at d 21 of age and allotted to 3 dietary treatment groups: (1) CON (diet containing no PP or FSBM), (2) FS (diet with 10% FSBM), and (3) PP (diet with 7% PP). All the diets contained 33% corn, 3% fish meal, 25% dried whey, 0.5% salt, and 4% vitamin-mineral premix. Inclusion of PP and FSBM was done by replacing 11% of soybean meal. Crystalline amino acids were added to match amino acid contents among the diets. Vegetable oils and corn starch was added to match the ME contents among the treatment diets. Pigs were housed individually and fed the experimental diets for 15 d. Each treatment consisted of 8 replicates. Weight gain and feed intake of individual pigs were measured during the 15 d period. On d 14, all the pigs were non-surgically fitted with indwelling jugular vein catheters. On d 15, all pigs were administered a dose of LPS (25 μg/kg BW) via the jugular vein catheter. The ADG was 130.3, 139.0, and 158.5 g for CON, FSBM, and PP, respectively but did not differ (P>0.05) among the treatments. The ADFI of PP (235.9 g) was greater (P<0.05) than CON (182.9 g) and FSBM (198.0 g). Blood samples (3 mL) were collected over a 6-h period at 30-min intervals (from 1-h pre- to 5-h post-LPS challenge) to determine plasma concentrations of cortisol. Plasma concentrations of cortisol in the FS pigs tended to be lower (P<0.10) than those of CON pigs at 30 (58 and 77 ng/mL for FS and CON, respectively), 210 (139 and 180), 270 (100 and 155), and 300 (89 and 132) min after LPS challenge. Collectively, these data indicate that pigs fed a diet containing fermented soybean meal tended to handle the immune stress better than the other groups.

Key Words: Fermented Soybean Meals, Lipopolysaccharides, Pigs

88 The effect of different levels of dietary mannan-oligosaccharide on specific cellular and humoral immune response in weaned piglets. I. Nochta*[1], T. Tuboly[2], V. Halas[3], and L. Babinszky[3], [1]*AGROKOMPLEX C.S.Z.R.T.*, *Zichyújfalu, Hungary*, [2]*Szent István University*, *Budapest, Hungary*, [3]*University of Kaposvár*, *Kaposvár, Hungary*.

Recently mannan-oligosaccharide (MOS) has been considered as a potential growth promoter due to its mode of action beneficially modifying the intestinal microflora and the immune status. Our trial objective was to study how different levels of dietary MOS effect the specific humoral and cellular immune response of weaned pigs. A total of 58 individually kept castrated piglets weaned at 28 d of age were used in two trial series. At 35 d of age 48 piglets were randomly allocated among dietary treatments [commercial piglet diet with 0; 1; 2 and 4g/kg AgriMos (yeast cell wall derivate MOS) or 0.2 g/kg Maxus-G (containing avilamycin; AB)] and immunized with an inactivated Aujeszky′s virus vaccine at day 0 and 14 of the trial. The remaining pigs were not immunized (NI) and given no supplement. All piglets were blood sampled weekly for 5 wk. Systemic humoral and cellular immune response was evaluated by a virus neutralization test and a lymphocyte stimulation test (LST) with Aujeszky mitogen, respectively. Statistical analysis was performed with ANOVA (SAS, 2004). Replication had no effect and according to the 2nd week results, the specific humoral response of pigs fed 1 g/kg MOS was better (3.37 vs. 1.92) than that in the other groups (P<0.0001). The effect of MOS on cellular immune response is shown in Table 1. To conclude, MOS has a dose response effect, and AgriMos at 1 g/kg was beneficial on the specific immune response of weaned pigs after 2 weeks. An earlier, stronger immune response directly after weaning is important in commercial conditions.

Table 1. The effect of MOS supplementation on LST with Aujeszky mitogen (log_2) in weaned piglets

	AgriMos (g/kg)							
week	0	1	2	4	AB	NI	RMSE	P
0.	0.88	1.01	1.01	1.00	1.01	1.01	0.13	NS
2.	1.57^{ab}	1.95^{a}	1.55^{ab}	1.56^{ab}	1.40^{bc}	1.04^{c}	0.33	***
4.	2.94^{a}	3.15^{a}	3.23^{a}	3.11^{a}	2.78^{a}	1.04^{b}	0.68	***

*** P<0.0001

Key Words: MOS, Weaned Pigs, Specific Immunity

89 Dietary supplementation with the Lactobacillus pentosus and/or inulin influences pH and volatile fatty acid characteristics in the colon. Z. McHugh, T. Sweeney, J. J. Callan, M. Ryan, and J. V. O'Doherty*, *University College Dublin*, *Ireland*.

Our objective was to investigate the effects of probiotic inclusion (Lactobacillus pentosus) and/or inulin on nutrient digestibility, nitrogen excretion, volatile fatty acids, gut microflora and in vitro ammonia emissions from finishing pigs. Sixteen boars (65 kg) were assigned to one of four dietary treatments as follows: (T1) wheat based diet; (T2) wheat based diet + 12.5 g/kg inulin; (T3) wheat based diet + 2.5 $times; 1010 CFU Lactobacillus (L) pentosus and (T4) wheat based diet + 12.5 g/kg inulin + 2.5 × 1010 CFU L. pentosus. Feed intake, nitrogen intake, coefficient of total tract apparent digestibility of nitrogen, dry matter, organic matter, ash, neutral detergent fibre (NDF), gross energy and nitrogen balance parameters were similar between treatment groups. Similarly there were no differences in manure volume, faeces:urine ratio and NH3-N per gram of N intake between treatments. Pigs offered diets containing L. Pentosus had a higher proportion of acetic acid in the caecum (P<0.05), a lower proportion of propionic acid in the colon (P<0.001), a higher proportion of isobutyric acid (P<0.001), a higher proportion of isovaleric acid (P<0.01) and a higher colon pH (P<0.01) than pigs offered diets without L. Pentosus. Pigs offered diets containing inulin had a higher proportion of butyric acid in the colon (P<0.05) than pigs offered diets containing no inulin. In conclusion, the inclusion of 2.5 x 1010 CFU L. Pentosus in the pig diet increased the proportion of branched chain fatty acids in the colon and increased colon pH suggesting that it could have a negative impact on environmental odour emissions, while the inclusion of inulin increased the proportion of butyric acid in the colon which has a beneficial health potential.

Key Words: Lactobacillus Pentosus, Inulin, Pigs

90 Response of nursery pigs to a synbiotic based on starch (prebiotic) and an anti-*Escherichia coli* K88 colicinogenic probiotic. S. K. Bhandari*, A. Setia, D. O. Krause, and C. M. Nyachoti, *University of Manitoba*, *Winnipeg, MB, Canada*.

Probiotics are live or dead microbial cultures that provide a benefit to the gut, whereas prebiotics are carbohydrates that selectively enhance proliferation of beneficial microbial populations. Synbiotics are combinations of probiotics and prebiotics that act synergistically. The objective of the present study was to design an *E. coli*-based colicinogenic probiotic that selectively inhibits pathogenic *E. coli* K88

in the presence of starch (prebiotic), and to evaluate its efficacy in an *in vitro* competition and in an *in vivo* piglet growth assay. From 463 environmental strains of *E. coli*, two strains (UM-2 and UM-7) with enhanced colicinogenic properties and rapid growth on starch were selected. Results of *in vitro* competition assays revealed that UM-2 and UM-7 suppressed *E. coli* K88 growth in the presence of starch. In the *in vivo* assay, 40 piglets with an initial BW of 4.82 ± 0.6 kg were assigned to 4 wheat-soybean meal-based diets consisting of a control with an antibiotic (C) and three diets with no antibiotics but containing UM-2 and UM-7 as the probiotics (PRO), 14% potato starch (PS), or a combination of 14% potato starch and probiotics (PRO-PS). PRO and PRO-PS diets were prepared each morning by mixing 50 ml of 9 x 10^{10} cfu/ml overnight probiotic cultures with fresh feed. Pigs were adapted to experimental diets from d 1 to 7. On d 8, pigs were orally inoculated with a 6 ml dose of 2 x 10^9 cfu/ml *E. coli* K88. ADFI, ADG, gain:feed ratio and fecal consistency scores (FCS) were monitored. ADFI and ADG before and after *E. coli* K88 infection were higher for the PRO-PS treatment compared with the other dietary treatments ($P < 0.05$). Gain:feed ratio was higher ($P < 0.05$) for the PRO-PS diet than C diet before infection and was similar to the C treatment after infection. PRO-PS and C fed piglets had a lower FCS ($P < 0.05$) than the PS and PRO fed piglets. In conclusion, colicinogenic probiotics and potato starch acted synergistically to reduce the negative effects of *E. coli* K88 infection in piglets.

Key Words: Pigs, Probiotics, *E. coli* K88

91 Dosage and efficacy of a novel *Saccharomyces cerevisiae* strain to enhance piglets productivity. M. Lucero P*[4,1], G. E. Lanz A[4,1], A. A. Martinez A[2], and J. A. Cuaron I[3], [1]*PAIEPEME A.C.*, *Querétaro, México*, [2]*CNID-Microbiología*, *México*, [3]*CNID-Fisiología Animal, INIFAP*, *Queretaro, México*, [4]*FESC UNAM*, *Ajuchitlan, Queretaro, Mexico*.

An advantage of using yeast as a probiotic is that as an eucariotic is compatible with antibiotherapies, Use of live yeast in piglets feed is an effective ADG enhancer (40 a 60 g) as long as *Saccharomyces cerevisiae* (SC) is from known effective strains, viable in the intestine and at doses greater than 8×10^9 cfu/g of product, or, a least, 1×10^7 cfu/g of feed, but some authors will defend effectiveness based on the immune–stimulant potential of the cell wall. This novel strain of yeast (Biocel) is of interest because the cell size (20×10^9 cfu/g) is about 50% of a normal SC, thus cell wall concentration is potentially doubled. An experiment using 600 piglets (a total of 60 experimental units) was conducted, from 10.19 ± 2.96 kg of initial weight during 5 weeks to measure growth performance effects of 5 yeast inclusion levels: 0, 0.25, 0.5, 1.0 and 2 kg/MT. The experiment was a Randomized Complete Block (2 nurseries) design. No differences ($P\geq0.33$) were detected in feed intake (0.75±0.142), morbidity or mortality (12.45±3.45) but, noted after 28 days, Biocel quadratically increased ($P\leq0.01$) ADG (380, 400 440, 470 and 460, SEM = 15.6 g) and feed efficiency (500, 530, 610 600 and 600, SEM = 15.86 g/kg). The inflection point of the curve showed that most effective levels of Biocel are between 1.25 y 1.50 kg/MT of feed (2.5 to 3×10^7 cfu/g).

Key Words: Yeast, Piglets, Saccharomyces Cerevisiae

92 Strategies for enhancing microbiological gut's barrier: BMD y BioPlus 2B. D. Munoz V*[1], G. E. Lanz A[1], M. Lucero P[1], A. Soria F[1], J. A. Renteria F[3], J. A. Cuaron I[3], S. Correa N[4], and S. Martinez[2], [1]*Paiepeme, A.C.*, *Queretaro, Mexico*, [2]*Alpharma*, *Mexico*, [3]*Fisiología Animal, INIFAP*, *Queretaro, Mexico*, [4]*Synbios*, *Mexico*.

The aim of this experiment was evaluating 2 strategies for clostridium control: a non absorbable antibiotic, bacitracine (BMD 0.3 kg/Mt), and a bacterial probiotic, BioPlus 2B (BP2B 0.5 kg/Mt), in finishing pigs. A total of 1125 pigs (half gilts and barrows) were used. Pigs were allotted in 56 pens, considering each pen as an experimental unit. Pigs were offered a single diet, containing therapeutical levels of antibiotic (AB) for respiratory diseases prevention (Clortetracicline 2 kg/Mt)). Treatments (TRT) were: 1) NEGCON, 2) BMD (first 21d), 3) BP2B (first 21d), 4) BMD + BP2B (first 21d). From day 22 to 41 AB was withdrawed from all diets and at day 42, experimental units were divided to form three new treatment: 5) AB + BMD, 6) AB + BP2B, and 7) AB + BMD + BP2B (each treatment with 8 experimental units) until day 84. Pigs were weighed every 21 days, ADFI, ADG, and Gain:Feed were estimated weekly. Feces samples were collected every feeding phase change for total anaerobians, coliforms, and salmonella counts. Mortality and its causes were registered the day they happened. After 84 d on trial there was a difference ($P\leq0.05$) on ADFI, BMD or BP2B pigs were better than CON; for ADG there was an interaction ($P\leq0.03$) between BMD and BP2P compared to CON pigs; there were no differences ($P\geq0.05$) between treatments for Gain:Feed. When AB was added to the diets, growth performance was improved (ADFI, 2.8 vs. 2.1 kg/day; ADG, 0.874 vs. 0.778 kg/day; Gain:Feed, 0.439 vs. 0.406 kg/day; $P\leq0.02$). There were no differences ($P\geq0.05$) in total coliforms, anaerobians or salmonella counts in feces. A few clostridium deaths were presented but were not associated to TRT. Combining the use of BMD and BP2B may help prevent clostridium infection and improve growth performance, thus the use of a therapeutical AB may enhance the effects of obtained by the other 2 products.

Key Words: Clostridium, Probiotic, Antibiotic

Nonruminant Nutrition: Poultry Nutrition - Protein and Amino Acids

93 Ileal amino acid digestibility of protein feed ingredients at 5 and 21 days of age by broiler chickens. J. M. Rynsburger*[1], D Hoehler[2], and H. L. Classen[1], [1]*University of Saskatchewan*, *Saskatoon, SK, Canada*, [2]*Degussa Corporation*, *Kennesaw, GA*.

The amino acid (AA) digestibility of feed ingredients by broiler chickens has most often been determined using older birds. However, these values are unlikely to predict AA digestibility in chicks during the initial period post-hatch because of their immature digestive tracts and lower nutrient utilization. Therefore, the objective of this research was to compare the ileal AA digestibility of selected protein sources using 5 and 21 d old broilers. Twenty two Ross x Ross 308 broilers were randomly assigned to eight battery cages per treatment. After sampling on d 5, remaining birds for 21 d sampling were distributed into 6 replicates of 7 birds. A 2 x 6 factorial arrangement was used to examine the effect of age on the ileal AA digestibility of six protein feed ingredients. Ingredients examined included canola meal, a canola protein concentrate, fishmeal, meat meal, peas and soybean meal. Diets were formulated to derive crude protein (approximately 18%) and

AAs solely from the test ingredient. AA digestibility was higher for 21 d old broilers than their 5 d old counterparts for most ingredients. Exceptions were all the AA digestibilities for soybean meal and the digestibility of CYS, MET + CYS, THR, ARG, VAL, HIS, GLY, SER, ALA and ASP for fish meal, which did not change significantly with age. The age-associated improvement in digestibility was highly variable and dependent on feed ingredient and amino acid with the percentage improvement ranging from -1.6 to 169%. In conclusion, ileal AA digestibility generally improves with age between 5 and 21 d of age but the response to age differs among ingredients and AAs. Therefore, accurate formulation of starter diets requires the use of AA digestibility values obtained in age-appropriate birds to ensure that diets meet AA requirements of broiler chicks for growth and other performance criteria.

Key Words: Chick, Ileal Amino Acid Digestibility, Protein

94 Effects of a reduction of dietary crude protein on performance and economics in commercial Ross 708 broilers. E. A. Guaiume*[1], J. D. Firman[1], D. Hoehler[2], P. B. Tillman[3], D. Burnham[4], J. Parcell[1], L. B. Linares[1], and A. Kamyab[1], [1]*University of Missouri*, *Columbia*, [2]*Degussa Corporation*, *Kennesaw, GA*, [3]*Ajinomoto Heartland LLC*, *Chicago, IL*, [4]*Aviagen Inc.*, *Huntsville, AL*.

A study was conducted to determine the effects of reduced dietary crude protein (CP) on biological and financial performance of Ross 708 broilers fed from hatch to week 8. 1440 straight-run broiler chicks were randomly assigned to 4 treatments with 12 replicate pens containing 30 birds each. Diets were formulated to be isocaloric and to have the minimum digestible level for lysine (Lys), and the same minimum ideal amino acid ratios to lysine for total sulfur amino acids (TSAA) and threonine (Thr) across the four phases [starter (0-2wks), grower (2-4wks), finisher (4-6½wks), and withdrawal (6½-8wks)]. An industry standard diet served as the control (CT). The remainder of the treatments (CT-0.7%, CT-1.4%, and CT-2.1%) had CP reduced in 0.7% increments. Birds were weighed at 2, 4, 6½, and 8 weeks of age for feed to gain calculation. At week 8, 4 birds per pen (48/trt) were sacrificed and had fat pad and carcass weighed, and carcass and meat yield determined. Feed cost savings (FCS) per metric ton (MT) of carcass, FCS/MT breast meat, income over feed cost/MT carcass, and income over feed cost/MT breast meat, were calculated. Treatments had no effect (P>.05) on performance throughout the 8-week period. There was a linear increase (P<.05) in fat pad as CP decreased. Treatments had no effect on carcass yield (P>.05); however, there was a linear decrease (P<.05) in breast meat yield as CP decreased. For carcass, relative to CT, FCS was $5.59/MT when CT-2.1% was fed; and for breast meat, FCS was $5.78 for CT-0.7%; $11.57 for CT-1.4%. However, when CT-2.1% was fed, there was an increase in feed costs ($14.07) per MT of breast meat when compared to CT. Overall, these results suggested a decrease of CP by 2.1%, as compared with industry standards, did not affect performance and carcass yield, but it decreased breast meat yield when CT-2.1% was fed.

Key Words: Low Crude Protein, Ross 708, Economics

95 Effects of dietary protein concentration and age on gut morphology, crude mucin, and sialic acid contents of ileal digesta of turkey poults. S. A. Adedokun*, D. M. Karcher, and T. J. Applegate, *Purdue University*, *West Lafayette, IN*.

The determination of the effects of age and dietary crude protein (DCP) concentration on factors contributing to the amount of amino acids of endogenous origin is important. The effects of DCP on crude mucin (CM), sialic acid (SA), and rate of gut turnover in turkey poults were measured at d 5 and d 21. Poults were fed a nitrogen-free diet (NFD), a diet containing 10% casein (completely digestible protein, CDP), and a corn-soybean meal (C-SBM) based diet. Each diet was fed to four replicate pens containing 60 and 12 birds which were sampled on d 5 and d 21, respectively. Crude mucin and SA (d 5 and d 21: n=4) contents as well as goblet cell number (GCN), villi height (VH), crypt depth (CD), and the ratio of GCN:VH (d 5 and d 21, n = 16 and 12, respectively) were determined. The amount of CM and SA (g/100 g of dry digesta) on d 5 was higher ($P < 0.05$) than on d 21 (NFD) but there was no difference in both CM and SA when CDP diet was fed. The C-SBM diet resulted in a higher ($P < 0.05$) CM concentration on d 5 than d 21 but the SA content was not different between the two ages. For all the dietary treatments, values for GCN, VH, and CD were higher ($P < 0.05$) on d 21 than on d 5. However, the GCN:VH for birds fed the NFD was 18% or 27% lower that birds fed the CDP or C-SBM diets, respectively. Therefore, previous results showing higher endogenous amino acid losses on d 5 relative to d 21 (NFD) could be attributed to higher CM and SA production.

Key Words: Goblet Cell, Mucin, Poults

96 Protein and amino acid retention in growing White Pekin ducks receiving graded levels of dietary crude protein. N. L. Horn* and O. Adeola, *Purdue University*, *West Lafayette, IN*.

Protein and AA accretion in growing male White Pekin ducks receiving 19, 21, 23, or 25 % dietary CP were investigated. On d 0, 16 ducklings were killed as an initial slaughter group. Two groups of 96 ducklings were assigned to the 4 dietary treatments, with 6 cages per treatment and 4 birds per cage, in randomized complete block design. One group was sacrificed on d 7 and the other group on d 14. There were linear increases ($P < 0$ .05) in gain and G:F for 7-d and 14-d old ducklings. Ash and fat accretion were not significantly affected by graded levels of dietary crude protein in 7-d old ducklings, for 14-d there was a linear decrease ($P < 0$ .05) in fat accretion as dietary CP increased, but no significant differences for ash accretion. Body protein accretion increased linearly from 2.83 g/d to 3.51 g/d for 7-d old birds, and from 2.35 g/d to 3.59 g/d for 14-d old birds ($P < 0.0001$). Body lysine accretion increased from 180 mg/d to 224 mg/d for 7-d old birds, and from 150 mg/d to 220 mg/d for 14-d old birds ($P < 0.0001$). Body threonine accretion increased from 104 mg/d to 129 mg/d for 7-d old birds, and from 85 mg/d to 130 mg/d for 14-d old birds ($P < 0.0001$). There was a linear relationship between crude protein intake and accretion rate of body protein in 7-d and 14-d old ducks. Lysine and threonine accretion also showed a linear relationship with body protein accretion in 7-d or 14-d old ducks. The results from this experiment showed that 30% or 28% of dietary protein was deposited in the body of 7-d or 14-d old ducks, respectively. Additionally, approximately 62 mg and 34 mg of lysine and threonine, respectively were accreted for every g of protein accretion.

Key Words: Dietary Crude Protein, Ducks, Protein Accretion

97 Effect of strain and immune status on dietary lysine requirements in broilers as determined by indicator amino acid oxidation. R. D. Kirschenman* and D. R. Korver, *University of Alberta*, *Edmonton AB, Canada*.

The effect of recovery from an acute-phase inflammatory response on lysine requirements was determined in random-bred (since 1957;R) and modern (Ross 308;M) broilers. At 10 d of age, 8 birds (4 R and 4 M) were placed in individual chambers and adapted to one of 7 diets containing 6.07, 7.18, 8.38, 9.38, 10.49, 12.14 or 13.24g/kg of dietary Lys (55% to 120% of NRC level for birds of this age). At 13 or 14 d of age, two birds per strain were either injected with lipopolysaccharide (LPS; I) or not injected (C) 12 hours prior to each 4-h oxidation. This time frame was based on prior data assessing changes in febrile response during recovery from LPS. There were 4 replicates per strain-LPS group at each level of Lys. Individual bird weights were taken before injection and before and after each oxidation. The M strain had higher BW than the R strain at all points ($P \leq 0.0001$). Injection caused the MI birds to have a lower final BW than the MC birds (P=0.0056) while the BW of R birds was not affected . BW of all birds increased during the oxidations. Mean Lys requirements for the MI and MC birds were 11.95 ± 1.09 g/kg diet and 10.14 ± 1.14 g/kg diet, respectively (P=0.7307). The mean Lys requirements for RI and RC birds were 9.98 ± 0.26 g/kg diet and 8.32 ± 0.11 g/kg diet, respectively (P=0.0231). The M birds had a higher requirement than the R birds ($P \leq 0.0001$). The results of this study demonstrate that M and R birds had different responses to an inflammatory challenge. LPS injection has been observed to decrease Lys requirement of birds during an immune challenge, however we observed an increase during the recovery phase in R birds. It is possible that the higher requirement is required to simultaneously support the diminishing inflammatory response as well as a recovery in growth rate. The lack of an LPS effect on Lys requirement in the M strain may indicate more rapid redistribution of nutrients back to growth or a different time course of recovery from the acute phase than the R strain. As this is a novel area of study, to date the mechanisms behind these changes are unknown.

Key Words: Immunity, Requirements, Lysine

98 Dietary protein quality and feed restriction influence abundance of PepT1 mRNA in the small intestine of two lines of broilers. E. Gilbert*[1], H. Li[1], D. Emmerson[2], K. Webb, Jr.[1], and E. Wong[1], [1]*Virginia Polytechnic Institute and State University*, *Blacksburg*, [2]*Aviagen®*, *Huntsville, AL*.

The objective of this study was to evaluate the effect of dietary protein quality on chicken intestinal peptide transporter 1 (cPepT1) mRNA abundance in two lines of broilers (A and B). Intestinal samples were collected from chicks at day of hatch (doh), and d 1, 3, 7 and 14 posthatch. At doh, chicks from both lines were randomly assigned to corn-based diets containing 20% CP with either soybean meal (SBM), a higher quality protein, or corn gluten meal (CGM), a lower quality protein, as the supplemental protein source. Birds were given ad libitum access to feed and water. Groups of chicks from both lines were also assigned to the SBM diet at a quantity restricted to that consumed by the Line A chicks fed CGM (diet consumed the least). PepT1 mRNA abundance was assayed by real time PCR using the absolute quantification method. Feed intake and BW were greater ($P < 0.0001$) for Line A compared with Line B. Chicks fed SBM had the greatest, while chicks fed CGM had the lowest BW and feed intakes ($P < 0.0001$). Chicks fed restricted amounts of the SBM diet had intermediate BW ($P < 0.0001$). With feed and protein intakes equal, greater BW in chicks fed restricted amounts of SBM compared with chicks fed CGM is reflective of SBM being a higher quality source of protein. Abundance of PepT1 mRNA was greater in Line B than Line A ($P = 0.03$). PepT1 mRNA was highest on d3, d14, and d7 and d14, in chicks fed diets containing SBM, CGM, and restricted SBM, respectively ($P = 0.005$). When feed intake was equal (CGM vs restricted SBM), a greater abundance of PepT1 mRNA was associated with the higher quality SBM ($P < 0.04$). When feed intake was restricted (SBM vs restricted SBM), a greater abundance of PepT1 mRNA was associated with the restricted intake ($P < 0.04$). These data suggest that both dietary protein quality and feed restriction influence expression of PepT1 mRNA in the small intestine of broiler chicks.

Key Words: Broiler, PepT1, Protein

99 Cysteine toxicity in chicks. R. N. Dilger* and D. H. Baker, *University of Illinois*, *Urbana*.

Previous work in our laboratory showed that 2.5% or more excess dietary L-cysteine (Cys), but not L-cystine, was lethal when fed to young chicks. Mortality resulting from ingestion of excess Cys was unique due to its acute nature; chicks began to perish after just 72 h of feeding. Our overall objective was to further characterize the unique phenomenon of Cys toxicity in chicks. Because Cys is a strong reducing agent, we attempted to counteract its effect using a strong oxidant (i.e., H_2O_2) in drinking water. Over a 9-d growth assay, chicks were provided corn-soybean meal diets containing 0 or 2.5% excess Cys, with or without 0.05% H_2O_2 in the water (i.e., the highest tolerable concentration as determined previously). Provision of H_2O_2 caused no untoward effects, but excess Cys reduced weight gain 24% and caused 44% mortality. The combination of excess Cys and H_2O_2-supplemented water still reduced weight gain 20%, but remarkably, no chick mortality was observed. Next, we evaluated the well-known principle that increased dietary CP concentration may minimize the noxious effects of consuming a single excess amino acid. Excess dietary Cys at 2.5% depressed ($P < 0.05$) weight gain in chicks fed corn-soybean meal diets containing 18% or 24% CP, but had no effect on chicks fed 30% CP diets. Cys-induced mortality, approximately 50%, was not affected by dietary CP concentration. Finally, we hypothesized that chick eating behavior (i.e., constant nibbling, many small meals) may impact the pernicious effect of excess Cys. Thus, food-deprived chicks were oral-gavaged with distilled water or a water solution providing 600 mg Cys (4.0 g/kg BW) in a bolus dose. On average, control chicks gained 21 g BW and consumed 56 g of diet during the 24-h post-intubation period, and no mortality occurred. In stark contrast, chicks gavaged with 600 mg Cys lost 28 g BW and consumed only 1 g of diet, and 83% of these chicks died (10 of 12 total) during the 24-h observation period. Collectively, these data highlight the unique phenomenon of dietary Cys toxicity, a finding potentially important for humans where over-the-counter Cys supplements are freely available without regulatory control.

Key Words: Cysteine, Toxicity, Chick

100 Digestibility and availability of the creatine source guanidino acetic acid in broilers. A. Lemme*[1], J. Tossenberger[2], and J. Ringel[1], [1]*Degussa GmbH - Feed Additives*, *Hanau, Germany*, [2]*University of Kaposvár*, *Kaposvár, Hungary*.

Creatine plays a central role in the cell energy metabolism and is considered semi-essential. Exogenous supplementation might be meaningful under certain conditions. In this context guanidino acetic acid (GAA, CreAmino™), which is a natural precursor of creatine in the metabolism, is a suitable feed additive. Knowledge on the metabolism of supplemental GAA is scarce and therefore an experiment with 24 fistulated male broilers (cannula fitted in colon) was conducted in order to investigate the digestibility and availability of supplemental GAA. A basal corn-soybean meal based diet was added with either no (CON), 0.06 % (recommended, T-B), or 0.60 % (overdose, T-C) GAA. Diets were offered for free consumption to 8 birds per treatment from 34-42 days of age. Feed intake was recorded and feces and urine were quantitatively collected twice a day from day 38-42. Samples of the four days were pooled per bird. All samples (feed, feces, urine) were analyzed for GAA, creatine, and creatinine, the latter being the excretion product of creatine. Subsequently, digestibility and utilization of digested GAA were calculated. No GAA was found in the basal diet while analytical results of the experimental diets confirmed the expected values. GAA excretion in feces was small in all treatments ($p>0.05$) resulting in true fecal digestibilities of 99.4 % and 98.9 % in T-B and T-C, respectively, suggesting a complete absorption. GAA, creatine, and creatinine were found in urine from CON birds as a result of de-novo synthesis. Consequently, utilization of the digested supplemental GAA was calculated by difference. Due to the fact that creatine and creatinine are derived from GAA, not only GAA, but also enhanced creatine and creatinine excretions must be attributed to the GAA supplementation and were thus all included in the calculations. Urinary GAA, creatine, and creatinine excretion were enhanced in T-B ($p>0.05$) and were significantly higher in T-C ($p<0.05$) compared to that of CON. Consequently, utilization of digested GAA was 77.1 % in birds of T-B, but only 46.4 % in those of T-C suggesting an effective excretion mechanism in case of overdosing GAA.

Key Words: Guanidino Acetic Acid, Availability, Broiler

101 Effect of amino acid formulation and synthetic amino acid supplementation on turkey tom performance. T. Applegate*[1], W. Powers[2], and R. Angel[3], [1]*Purdue University*, *West Lafayette, IN*, [2]*Michigan State University*, *East Lansing*, [3]*University of Maryland*, *College Park*.

A two by two factorial experiment was conducted to determine whether diets formulated with either two (Lys and Met) or three (Lys, Met, and Thr) synthetic AA to 100% or 110% of NRC (1994) AA recommendations would affect performance of turkey toms. Diets were formulated with corn, soybean meal (SBM), and six percent meat and bone meal. Diets were formulated to maximize SBM inclusion when formulated with two synthetic AA thereby resulting in 2.0, 1.5, 1.4, and 1.0 %-units more CP than diets containing three synthetic AA at 4 to 8, 8 to 12, 12 to 16, and 16 to 20 wk of age, respectively. Each diet was fed to 12 replicate pens of birds with 10 birds per pen. Body weight, feed intake, and feed/gain was not affected by AA formulation or synthetic AA supplementation (average 20 wk BW = 20.7 kg). Similarly, the weight of the Pectoralis (P) major at 20 wk of age was not different between birds fed different diet regimens (left P. major = 1.88 kg; 9.13% of BW). Calculated nitrogen (N) intake were affected by diet with birds fed 100% NRC AA consumed 139 g (7.05%) less N than those fed 110% NRC AA ($P < 0.0001$). Similarly, birds fed three versus two synthetic AA consumed 146 g less feed N (7.4%) to 20 wk of age ($P < 0.0001$). These data suggest that diets containing AA formulations above NRC (1994) recommendations do not provide any additional performance or P. major yield benefits. In addition, formulation with three synthetic AA results in a considerable reduction in N consumed.

Key Words: Amino Acid, Crude Protein, Turkey Tom

102 Increased dietary balanced protein levels at varying length of application during the starter period of broilers. A. Lemme*[1], M. G. T. Janssen[2], P. J. A. Wijtten[2], J. K. W. M. Sparla[2], and M. S. Redshaw[1], [1]*Degussa GmbH - Feed Additives*, *Hanau, Germany*, [2]*Provimi B. V.*, *Rotterdam, The Netherlands*.

Amino acid supply during early stage of life is supposed to have a strong impact on the development of broilers. Question about the optimum level of dietary balanced protein and the optimum duration of supply was raised. Therefore, experimental corn-wheat-soybean meal based diets with graded levels of balanced protein (BP) corresponding to 11.0 (control), 12.6, 14.2, 15.7, and 17.3 g true fecal digestible lysine per kg feed were produced. Amino acid profiles were kept identical in all diets. While the control was fed from day 1 through day 14, diets with higher BP were fed from day 1 either for two, four, eight, or twelve days of life (4x4). A total of 1728 male Ross 308 broilers were equally assigned to the 17 treatments comprising either eight (control) or four cages with 24 birds each. After feeding the experimental pelleted diets, dietary BP was reduced to the control level (11.0 g dig. Lys/kg) in two steps (2-day transition period) in order to avoid too strong changes in amino acid supply especially in the treatments with higher BP supply. At 14 days of age weight gain and feed conversion were significantly improved by increasing BP levels (both $p<0.05$). This non-linear effect was most pronounced when feeding the diets over 12 days (gain: numerically; FCR: interaction $p<0.05$) suggesting optimum performance at 15.7 g dig. Lys. At day 14 two birds per pen were selected for dissection. Weight and length of the empty small intestine were determined. Prolonging the length of feeding the experimental diets containing 12.6 g dig. Lys/kg and more from 2 to 12 days significantly increased the weight of the duodenum and jejunum (% of body weight, $p<0.05$) whilst dietary BP itself had no effect. However, small intestine weight of the control treatment was similar compared with that of birds receiving the experimental diets for 8 and 12 days.

Key Words: Balanced Protein, Broiler, Phase Length

103 Response of vaccinated starting broilers to the inclusion of NEAA as gelatin to high and low CP feed while maintaining EAA requirements. R. Lehman* and E. T. Moran, *Auburn University*, *Auburn, AL*.

Vaccination for coccidiosis is now common as producers remove antibiotics from broiler feeds. Because of the extensive use of NEAA for mucin formation, the use of low CP may exacerbate vaccination response during the first three weeks. Inclusion of NEAA, particularly glycine and proline, as gelatin was evaluated for any recuperative advantage when vaccinated and non-vaccinated birds received high

and low CP diets. Ross X 708 chicks (1280; 64 pens) were sexed; half were vaccinated with Coccivac-D, and placed in floor pens while the other half received Salinomycin. Two low CP corn-soybean meal diets (21% CP and 21% CP containing 2% gelatin) and two high CP diets (23% CP and 23% CP containing 2% gelatin) were fed. Birds that were vaccinated had significantly lower body weight gain (P<.001) and higher feed conversion (P<.001) compared to those that were not vaccinated. However, vaccinated birds with gelatin in their diets had a greater BW gain (P<.05) and lower feed conversion (P<.01) than vaccinated birds with no gelatin in their diets. Gelatin present in diets increased BW gain (P<.05) and greatly lowered feed conversion (P<.001). The growth performance of the broilers was not affected by the amount of crude protein in the diet. The presence of gelatin in diets of vaccinated broilers appears to aid in BW gain and feed conversion during the first three weeks.

Key Words: Crude Protein, Coccidiosis, NEAA

104 Evaluation of isoleucine and valine limitation in diets for heavy high-yield broilers. A. Corzo*[1], M. T. Kidd[1], J. Collier[1], W. A. Dozier, III[2], and D. Hoehler[3], [1]*Mississippi State University*, *Mississippi State*, [2]*USDA-ARS*, *Mississippi State, MS*, [3]*Degussa Corporation*, *Kennesaw, GA*.

Two studies were conducted from 35 to 54 d of age using Ross × Ross 708 males. The first study was composed of three dietary treatments designed to evaluate the impact on performance of broilers when neglecting the Val and Ile nutrient minimums during formulation: a control diet formulated to meet or exceed all critical amino acid needs (0.80% dig Val and 0.71% dig Ile); a diet formulated to meet the minimum needs of all critical amino acids and allowing L-Thr to enter formulation (0.74% dig Val and 0.65% dig Ile); a third diet with no nutrient minimum given to dietary Val and Ile (0.67% and 0.58% dig, respectively). All treatments contained eight replicate pens (12 broilers/pen). The second study was a factorial design with three Ile (61, 64.5 and 68) and three Val (70, 74 and 78) ratios to Lys, for a total of nine treatments, each containing eight replicate pens (12 broilers/pen). Data was analyzed for two-way interactions first, and then main effects. In the first study, feed conversion was minimized (P<0.05) with the control diet when compared to the Val/Ile deficient diet, while the second diet had an intermediate value. The same statistical response was observed when expressing BWG as a function of feed cost. The Val/Ile deficient diet was economically less profitable (P=0.06) than the control diet, while the second diet had an intermediate value. The data from the second study showed that no two-way interactions were observed. A main effect for Ile was observed on BWG, where an increase (P=0.06) in the weight gain was observed as the Ile level increased in the diet. Feed conversion values showed that the Ile/Lys ratio of 61% was poorer (P<0.01) when compared to the other two treatments. No Val main effect was observed for live performance. No main effects for either Val or Ile were observed for carcass traits. It was shown how neglecting critical amino acid needs beyond Thr can be detrimental to performance and profitability. It can also be said that during latter phases critical amino acid needs can be met via feed consumption making it difficult to comprehend the limitation of critical amino acids.

Key Words: Broiler, Isoleucine, Valine

Nonruminant Nutrition: Swine Mineral Nutrition and Metabolism

105 Dietary selenium regulation of the rat liver and kidney selenoproteomes. K. M. Hargrave*, J. K. Evenson, A. M. Rothert, and R. A. Sunde, *University of Wisconsin*, *Madison*.

The rodent selenoproteome consists of 24 selenoproteins. Using microarray analysis, we have identified 8 liver and 5 kidney selenoprotein mRNAs, including glutathione peroxidase-1 (GPX1), that were significantly down-regulated in mice fed a selenium (Se)-deficient diet. Our current objective is to identify the rat liver and kidney selenoproteins expressed, and regulated by dietary Se. We conducted 2 studies; in Study 1, male rats were fed a torula yeast based diet deficient in Se, or containing 0.02, 0.05, 0.075, 0.1, 0.15, 0.2, or 0.3 µg Se/g diet for 28 d following weaning. Total liver and kidney RNA from 3 rats per diet were analyzed by quantitative real-time RT-PCR for the mRNA abundance of the selenoproteins regulated in the mouse. Study 2 was conducted with the addition of diets containing 0.5 and 1.0 µg Se/g diet. Se status of these animals was determined by plasma GPX3 and red blood cell GPX1 activities. In Study 1, rat liver GPX1, Selenoprotein (Sel) H, and SelW were highly down-regulated ($P < 0.001$) by dietary Se, similar to the mouse. In each case, mRNA abundance neared a plateau by 0.075 µg Se/g diet. Furthermore, rat SelK, SelP, and Thioredoxin Reductase-1 (TR1) were moderately and significantly ($P < 0.01$) regulated, whereas, GPX4, SelM, and TR2 were not. In the kidney, GPX1 was highly ($P < 0.05$) and SelW moderately ($P < 0.05$) down-regulated by dietary Se. Unlike in the mouse, kidney SelH, SelM, and GPX3 were not regulated, similar to GPX4. In Study 2, plasma GPX3 and red blood cell GPX1 activities in Se-deficient rats were dramatically down-regulated ($P < 0.001$) compared to Se-adequate levels. In summary, GPX1 mRNA, when assayed by RT-PCR, as well as activity are decreased dramatically in Se-deficient rats, indicating that this is a good model in which to test mRNA regulation of the complete selenoproteome. No selenoprotein tested thus far has exhibited a pattern of regulation different or more dramatic than for GPX1. In the rat model, however, there appears to be fewer selenoproteins under significant dietary Se regulation than previously observed in the mouse (6 vs 8 in the liver and 3 vs 5 in the kidney).

Key Words: Selenium, mRNA Expression, Rat

106 Copper can be absorbed as a Cu-peptide chelate through the PepT1 transporter in the jejunum of weanling pigs. B. E. Aldridge*, K. L. Saddoris, and J. S. Radcliffe, *Purdue University*, *West Lafayette, IN*.

Jejunal tissue was harvested from eighty-four pigs on d 6,8,10 or 14 post-weaning and mounted in modified Ussing chambers to investigate the route of Cu absorption from Bioplex® Cu and $CuSO_4$. Tissues were challenged in a 2 x 2 factorial arrangement with two Cu sources (Bioplex® Cu and $CuSO_4$) with and without an inhibitor (valcyclovir) of the di- and tri-peptide transporter, PepT1. Active ion transport was measured by changes in short circuit current (Isc) following the

addition of Cu to the mucosal buffer. Additionally, Cu disappearance from the mucosal buffer was determined by atomic absorption spectrophotometry following stabilization of the Isc, post-Cu challenge. A Cu source x PepT1 inhibitor interaction (P=0.05) was observed for the change in Isc following Cu addition to the mucosal buffer. The change in Isc was 78% greater when Bioplex® Cu was added compared with $CuSO_4$. However, the addition of valcyclovir, an inhibitor of PepT1 reduced the response by 40% for Bioplex® Cu, but did not affect $CuSO_4$. This indicates that some of the change in Isc after adding Bioplex® Cu was the result of peptide absorption. A Cu source x PepT1 inhibitor interaction (P=0.054) was also observed for Cu concentration remaining in the mucosal buffer. Cu concentration in the mucosal buffer was 20% higher with Bioplex® Cu, in the presence of the PepT1 inhibitor, than without the inhibitor. However, the PepT1 inhibitor had no effects on mucosal buffer Cu concentrations when $CuSO_4$ was added. This indicates that some of the Cu in Bioplex® Cu is absorbed through PepT1.

Key Words: Pig, Copper, PepT1

107 The feeding of low-P diets to weanling pigs stimulates Na^+-dependent phosphate transport by a post-translational mechanism in the jejunum. K. L. Saddoris* and J. S. Radcliffe, *Purdue University*, *West Lafayette, IN*.

Thirty-six crossbred gilts (6.6±0.16 kg BW) were utilized to determine the mechanism of action through which Na^+-dependent P transport is stimulated in weanling pigs fed a low-P diet. Pigs were weaned at 19 d of age and allowed a 10 d adaptation period to a dry diet. Pigs were blocked by BW and randomly assigned to a 0.07 or 0.40% aP diet and injected i.p. once a day for 3d with actinomycin D (0.12 mg/kg BW), cycloheximide (0.40 mg/kg BW), or saline. Pigs were then euthanized and jejunal samples were removed and mounted in modified Ussing chambers for determination of electrophysiolgical properties. Additionally, mRNA expression (quantitative RT-PCR) of NaPi-IIb was determined from jejunal mucosal scrapings. As expected P intake was lower (P≤0.0001) for pigs fed the low-P diet compared to pigs fed the high P diet (125 vs 601 mg/d). Additionally, pigs injected with actinomycin D or cycloheximide had lower P intakes (P≤0.001) and lost a greater amount of BW (P<0.01) during the trial compared to pigs injected with saline. Basal short-circuit current (Isc) and resistance did not differ (P≥0.10) between treatment groups. Na^+-dependent P uptake increased (P≤0.05; 15.48 to 23.39 $\mu A/cm^2$) as the concentration of P in the diet was decreased as measured by the change in Isc. However, no injection or diet × injection effects were observed for Na^+-dependent P uptake despite 2.3-fold decreases in P intake in pigs injected with actinomycin D or cycloheximide compared to pigs injected with saline. Expression of NaPi-IIb gene could not be detected in jejunal samples indicating an 80% decrease in P intake over 3 d failed to induce expression of NaPi-IIb transcript. Overall, consumption of a low P diet stimulates Na^+-dependent transport in the jejunum and this increase is not prevented by administration of either a transcriptional or translational inhibitor and occurs independently of an increase in NaPi-IIb cotransporter mRNA. Therefore, in the jejunum of weanling pigs, regulation of Na^+-dependent P uptake is occurring through a post-translational mechanism.

Key Words: Phosphorus, Intestine, Pigs

108 Dietary supplementation with zinc oxide decreases the expression of the stem-cell factor in the small intestine of weanling pigs. D. Y. Ou[1], D. F. Li*[1], Y. H. Cao[1], X. L. Li[1], J. D. Yin[1], S. Y. Qiao[1], and G. Y. Wu[2], [1]*China Agricultural University*, *Beijing, China*, [2]*Texas A&M University*, *College Station*.

Supplementation of diets with a high level of zinc oxide has been shown to reduce the incidence of diarrhea in weanling pigs, but the underlying mechanisms remain largely unknown. Intestinal-mucosal mast cells, whose maturation and proliferation is under the control of the stem cell factor (SCF), play an important role in the etiology of diarrhea by releasing histamine. The present study was conducted to test the novel hypothesis that dietary supplementation with zinc oxide inhibits SCF expression in the small intestine, thereby reducing the number of mast cells, histamine release, and diarrhea. In Experiment 1, Piglets (28 d) were weaned and fed diet containing 100 or 3000 mg/kg zinc (as zinc oxide) for 10 d (16 piglets/group). In Experiment 2, sixteen piglets (28 d) were assigned randomly to two groups as in Experiment 1, except that the two groups were pair-fed the same amount of feed. Supplementation with a high level of zinc oxide reduced the incidence of diarrhea in weanling piglets. Dietary Zn supplementation reduced the expression of SCF gene at both mRNA and protein levels, the number of mast cells in the mucosa and submucosa of the small intestine and histamine release. Collectively, our novel results indicate that dietary supplementation with zinc oxide inhibits SCF expression in the small intestine, leading to reductions in the number of mast cells and histamine release. These results may have important implications for the prevention of weaning-associated diarrhea in piglets.

Key Words: Zinc Oxide, Mast Cells, Histamine

109 Net portal absorption of inorganic zinc and zinc-amino acid chelates by growing pigs. R. D. Mateo*[1], M. I. Perret-Gentil[2], M. W. Hart[1], R. A. Samford[3], and S. W. Kim[1], [1]*Texas Tech University*, *Lubbock*, [2]*Texas Tech Health Sciences Center*, *Lubbock*, [3]*Albion Advanced Nutrition*, *Clearfield, UT*.

This study was conducted to determine and compare net portal absorption (NPA) of zinc from zinc sulfate, zinc-methionine chelate (Albion Advanced Nutrition), and zinc-amino acid chelate (Albion Advanced Nutrition). Three pigs (21.5±0.7 kg BW) were surgically fitted with catheters into the carotid artery, portal vein, mesenteric vein, and pyloric region of the stomach and allotted to 3 x 3 Latin square design with 3 treatments: Injection of zinc sulfate (ZS); zinc-methionine chelate (ZM); and zinc-amino acid chelate (ZAA) through the pyloric stomach catheter and 3 periods (48-h intervals). Each period was composed of 24-h feeding (0.09 kg x $BW^{0.75}$), 19.5-h fasting, and 4.5-h infusion. A corn-soybean meal based diet with 18.2% CP and 3.35 Mcal ME/kg was fed to pigs before fasting. Para-aminohippuric acid (PAH) was infused (3.2 mg/min) into the mesenteric vein for a 4.5 h period. Zinc (230 mg) from one of the three aforementioned sources was injected into the lumen of the pyloric catheter 60 min after beginning the PAH infusion period. Blood samples (3 mL) were collected simultaneously from the carotid artery and portal vein catheters at -60, -30, 0, 15, 30, 45, 60, 90, 120, 150, and 210 min relative to zinc injection to measure PAH and zinc concentration in the plasma. Zinc NPA was calculated by multiplying the portal vein plasma flow rate by the porto-arterial plasma zinc concentration. Blood flow averaged 1.38±0.23 L/min. Zinc NPA from ZS peaked (P<0.05) at 150 min (0.94 mg/min). Zinc NPA from ZM peaked (P<0.05) at 30

and 120 min (2.40 and 2.24 mg/min, respectively). Zinc NPA from ZAA peaked (P<0.05) at 30 and 150 min (1.59 and 3.12 mg/min, respectively). ZM had greater (P<0.05) zinc NPA than other NPA at 60 min (-0.53 vs. 0.43 mg/min) and ZAA had greater (P<0.05) zinc NPA than other NPA at 150 min (0.94 vs. 3.12 mg/min). This study suggests that zinc from organic sources (ZM and ZAA) is absorbed faster and more than zinc from zinc sulfate.

Key Words: Net Portal Absorption, Zinc Amino Acid Chelate, Pigs

110 The effect of varied levels of E. Coli. phytase on phosphorus balance in weanling pigs. T. C. Tsai*[1], C. R. Dove[1], M. J. Azain[1], and M. Bedford[1], [1]*University of Georgia*, *Athens*, [2]*Syngenta Animal Nutrient*, *RTP, NC*.

The objective of this study was to examine the effect of an E. Coli. phytase on phosphorous (P) balance in weaning pigs. The study was conducted in a 2 x 5 factorial arrangement of treatments. Two levels of P, low-P (LP, 0.13% avail. P, no inorganic P added) and high-P (HP, 0.35% avail. P, with 1.15% dicalcium phosphate) were supplemented with 0, 250, 500, 2500, and 12500 U/kg of E. Coli-derived phytase. All diets were formulated to contain 20% CP, 1.15% lysine and 0.75% calcium (Ca). The study involved a total of 80 pigs (IW =18 kg, 4 wk post-weaning) in 4 replicates of 14 d each (10 d adaptation, 4 d collection). Pigs were housed in metabolism cages and fed twice each day. Growth rate and G:F were lower in pigs fed the LP diet. The addition of phytase improved ADG and G:F (P<0.01), with performance of pigs fed 2500 and 12500 U/kg phytase being similar to that of pigs on the HP-control diet. The improvements in performance were greater in the pigs fed the LP diet. Fecal P (g/d) was reduced as phytase level increased in both diets (P<0.0001), but the magnitude was greater in the LP diet. In the LP diet, apparent total tract digestibility (ATTD) for P was improved by 36, 18, 49, and 76% in pigs fed 250, 500, 2500, and 12500 U/kg, respectively (P<0.0001). In the HP diet, ATTD was improved from 39 to 45% with phytase. Urinary P was less than 5% of total P excretion in pigs fed the LP diet and was not affected by phytase. Urinary P increased with phytase addition to the HP diet and accounted for 30% of the total P excretion on the HP diet with 12500 U phytase. Calcium retention (%) was improved (P < 0.001) by the addition of phytase to both LP and HP diets. Urinary Ca was reduced by phytase (P<0.001) in both diets. These results suggest that E. Coli. phytase addition to a LP diet can efficiently reduce total P excretion and improve growth performance.

Key Words: Phytase, Digestibility, Weaning Pigs

111 Effects of different available-phosphorus levels in diets on nitrogen and phosphorus digestibilities in growing pigs. X. Wu[1], Y. L. Yin[1], G. Y. Wu[1,3], T. J. Li[1], Y. G. Zhang[1], F. Y. Yan[1], R. L. Huang[1], and M. Z. Fan*[4], [1]*Institute of Subtropical Agriculture, The Chinese Academy of Sciences*, *Changsha, Hunan, China*, [2]*Huazhong Agricultural University*, *Wuhan, Hubei, China*, [3]*Texas A&M University*, *College Station*, [4]*University of Guelph*, *Guelph, Ontario, Canada*.

This study was conducted to determine the effect of different available-phosphorus levels in diets on the digestibilities of dietary nitrogen (N) and phosphorus (P) in growing pigs, using a 4x4 Latin square design. Four cornstarch- and soybean meal-based diets were fed to 4 barrows (average initial BW of 52 kg) housed individually in stainless cages. Dicalcium phosphate was used as the major source of dietary inorganic P whose supplemental levels were 0.0, 0.12, 0.24 and 0.36% in Diets 1, 2, 3, and 4, respectively. The corresponding levels of available P in the diets were 0.13, 0.15, 0.17, and 0.19%, respectively. Each experimental period comprised 12 d, including 5-d adaptation and 3-d collection of fecal samples. The results indicated that apparent P digestibilities in Diets 1, 2, 3, and 4 were 20.97%, 25.27%, 37.91%, and 46.15%, respectively (P<0.01) and true P digestibilities were 53.00%, 53.78%, 65.19%, and 68.09%, respectively (P>0.05). Fecal P outputs decreased (P < 0.05) with decreasing dietary P intakes. However, there were no differences (P>0.05) in apparent N digestibilities or fetal N outputs among the different groups of pigs. We conclude that feeding diets containing 0.12% to 0.24% dicalcium phosphate is effective in reducing P excretion from growing pigs.

Key Words: Available Phosphorus, True Digestibility, Growing Pigs

112 Effect of mineral status and calcium (Ca) concentration on phosphorus (P) and Ca utilization in piglets. M. P. Letourneau Montminy*[1], C. Jondreville[2], D. Sauvant[3], M. Magnin[4], C. Pomar[5], and P. Lescoat[1], [1]*INRA UR83*, *Nouzilly, France*, [2]*INRA USC340*, *Vandoeuvre-les-Nancy, France*, [3]*INRA UMR791*, *Paris, France*, [4]*BASF Nutrition Animale*, *Château-Gontier, France*, [5]*Agriculture et Agroalimentaire Canada*, *Lennoxville, Canada*.

Current formulation system may inadequately account for the impact of factors that modify Ca and P utilization by the animal. These factors could be related to the animal (e.g.: mineral status) or to the diet (e.g.: Ca concentration). An experiment was conducted to study the impact of the initial mineral status of animals and of Ca and P dietary supply, with and without phytase on P and Ca utilization by piglets. They were initially weighing 10 kg and fed maize-soybean meal diets providing adequate amounts of all nutrients except P and Ca. This study was divided into two successive periods. The first 10-day period aimed at preparing piglets with two mineral status. Sixty piglets were fed diets providing either adequate (1.42 and 0.80 %, respectively) or low (0.67 and 0.43 %, respectively) amounts of Ca and tP. At the end of this period, 6 piglets from each diet were slaughtered. The 24 remaining piglets from each diet were fed one of the 4 experimental diets for a 24-day experimental period. All four experimental diets displayed similar amounts of tP (0.56%). They contained Ca concentrations and microbial phytase (Natuphos) at (1.0%, 1000 IU), (1.0%, 0 IU), (0.6%, 1000 IU) and (0.6%, 0 IU) respectively. Body weight gain and feed conversion ratio were independent of the initial mineral status (P > 0.05). Femur ash concentration and plasma P decreased while plasma Ca and alkaline phosphatase activity increased with decreased P and Ca dietary concentration (P < 0.05) during the first 10-day period, indicating that two different mineral status could be differentiated. By the end of the 24-day experimental period, femur ash concentration was independent of the initial mineral status of the pigs (P > 0.05). This observation was in accordance with an improved Ca and P digestibility (P < 0.05) in initially depleted pigs compared to pigs with a normal initial mineral status. Lowering dietary Ca increased P digestibility (P < 0.05). Mineral status and lower dietary Ca can improve utilization of P in piglets.

Key Words: Piglets, Phosphorus, Calcium

113 Exogenous glutathione reduces cadmium toxicity to giant freshwater prawns *Macrobrachium rosenbergii*. W. Y. Chu*[1], Y. L. Yin[1], K. Yao[1], T. J. Li[1], R. L. Huang[1], and G. Y. Wu[1,2], [1]*Institute of Subtropical Agriculture, The Chinese Academy of Sciences*, *Changsha, Hunan, China*, [2]*Texas A&M University*, *College Station*.

This study was conducted to test the hypothesis that exogenous glutathione (GSH) can improve antioxidant function and the ultrastructure of hepatopancreas (HP) in cadmium (Cd)-treated freshwater prawns *Macrobrachium rosenbergii*. Data are expressed as means ± SEM. The prawns (BW 11.3 ± 0.13 g and length 104.6 ± 2.4 mm) were fed a pellet diet consisting of 40% groundnut oil cake, 15% soybean meal, 15% fish meal, 28% rice bran, and 2% vitamin-mineral premix. Eighty prawns were assigned randomly into four groups (20 prawns/group). Groups 1 and 2, which were maintained in Cd-free water, received intraperitoneal (i.p.) administration of 0 or 0.21 g GSH/kg BW once daily for 7 d. Groups 3 and 4, which were maintained in water containing 0.06 mg Cd/L, received i.p. administration of 0 or 0.21 g GSH/kg BW once daily for 7 d. On d 3 and 7, HP tissues were obtained from 10 prawns/group for determining total glutathione, the thiobarbituric acid reactive substance, and enzyme activities. Concentrations of total GSH (1.13 ± 0.31 μmol/g tissue) in HP did not alter ($P>0.05$) in prawns not receiving Cd or GSH treatment over a 7-d period. Compared with the prawns not treated with GSH, administration of GSH increased ($P<0.05$) concentrations of total GSH in HP by 2.8- and 4.6-fold on d 3 and 7, respectively. The GSH treatment reduced ($P<0.05$) Cd-induced lipid peroxidation by 61% and increased ($P<0.05$) the activities of superoxide dismutase by 27% and glutathione peroxidase by 67% on d 7. The structural integrality of most organelles (e.g., nucleus, mitochondria, and rough endoplasmic reticulum) in HP was severely damaged in Cd-treated prawns receiving no GSH administration. GSH treatment ameliorated ($P<0.05$) the Cd-induced damage in HP. These results suggest that GSH administration is beneficial for reducing Cd toxicity to HP of the freshwater prawn.

Key Words: Glutathione, Cadmium, Antioxidant Defence

114 Factors affecting phytase activity: implication for assay development. M. F. Isaksen*[1,2] and S. Dalsgaard[1,2], [1]*Danisco Innovations*, *Brabrand, Denmark*, [2]*Danisco Animal Nutrition*, *Marlborough, Wiltshire, UK*.

Phytase is an enzyme used in feed to improve phytate phosphorus digestibility and these effects *in vivo* are dose dependent. The feed industry, therefore, needs an assay which consistently quantifies phytase activity in feed. To get a better understanding of the factors influencing phytase quantification, three different sources of phytase (E.coli, Aspergillus, Peniophora) were assayed using different methods presently used by the feed industry for determining phytase in feed. The study included the AOAC method. The standard unit definition for all assay methods was the same i.e. pH 5.5 and at 37°C, and only minor differences in the assay methodologies were noticeable. Nevertheless, the differences in measured activity between the assays were significant, ranging from no difference to 50% or more for the three phytase sources. The calcium concentration used in the assay was found to have a large effect on the recovery of the three tested phytases, with the E.Coli phytase giving lower than expected recoveries and the Peniophora phytase giving higher than expected recoveries. This study demonstrates that phytases that are quantified in units with the same basic definition, can give very different recoveries in in-feed assays, depending on quite subtle changes in assay methodology. The number of units assayed is dependent on several factors, including calcium concentration in the extraction procedure, assay buffer types and extraction time. Care should therefore be taken when interpreting the results from different phytase products, when using one specific assay method. *In vitro* comparisons should always be linked to in vivo estimations of bio-efficacy.

Key Words: Enzymes, Phytase, Assay

115 Influence of dietary reductions in CP, P, and trace minerals on DM, N, P, and mineral excretion in finishing pigs. M. Lachmann*, S. Carter, J. Bundy, S. Jenkin, and Z. Marable, *Oklahoma State University*, *Stillwater*.

Seventy-six crossbred pigs (28 kg BW) were used to evaluate the effects of reducing dietary CP, P, and trace minerals (TM) on DM, N, P, and mineral excretion during a 110-d finishing period. Pigs were blocked by BW and randomly allotted to dietary treatments. Pigs were housed in an environmentally-controlled building with 4 identical rooms, each room having a shallow pit, pull plug system (19 pigs/room, 2 rooms/trt). The control diet was a fortified corn-soybean meal diet (19.3, 17.2, 15.1 and 13.6% CP; 0.50, 0.46, 0.43, and 0.40% P) with 0.1% inclusion of TM premix for Phases 1 (28-54 kg), 2 (54-82 kg), 3 (82-100 kg) and 4 (100-118 kg). Diet 2 (LPPM) was similar to the control with the exceptions that CP was reduced by 3% units, P by 0.1% units, phytase added (500 FYT/kg), and TM premix reduced by 50, 77, 83 and 100% for Phases 1 - 4, respectively. The TM premix supplied 11, 110, 26, and 110 ppm of Cu, Fe, Mn, and Zn. Diets were formulated on true dig. Lys (0.92, 0.79, 0.65, and 0.56%) and Lys, Met, Thr and Trp were added to LPPM on an ideal basis. Pig weight, feed intake, pit volume, and slurry pH were measured weekly. Feed and slurry samples were collected weekly for DM, N, P, and mineral analyses. Slurry concentrations of N (2,010 vs. 1,438 ppm) and NH_4-N (940 vs. 632 ppm) tended to decrease ($P = 0.06$) with LPPM, while P (472 vs. 259 ppm) and pH (7.07 vs. 6.59) were reduced ($P < 0.05$). Diet did not affect ($P > 0.10$) growth performance (ADG = 839 g, G:F = 0.37). Daily intakes of N (54.4 vs. 45.7 g) and P (9.8 vs. 7.5 g) decreased ($P < 0.05$) with LPPM. Daily DM (293 vs. 260 g), N (33.5 vs. 23.1 g), and P (6.2 vs. 4.1 g) excretion were reduced ($P < 0.05$) for pigs fed LPPM. Excretion of macro- and TM was reduced by more than 11 and 38%, respectively. Cumulative DM (32.2 vs. 28.5 kg), N (3.7 vs. 2.5 kg), and P (0.68 vs. 0.45 kg) excretion per pig were reduced ($P < 0.05$) by 12, 31 and 34%, respectively with LPPM. These results suggest a marked reduction in nutrient excretion for pigs fed LPPM during the finishing period.

Key Words: Pigs, Diet, Nutrient Excretion

116 Factors affecting pre-ovulatory follicular diameter and ovulation rate following GnRH administration in anestrous beef cows. J. A. Atkins*[1], T. W. Geary[2], K. J. Wells[3], M. C. Lucy[1], and M. F. Smith[1], [1]*University of Missouri*, *Columbia*, [2]*USDA ARS Fort Keogh*, *Miles City, MT*, [3]*Michigan State University*, *East Lansing*.

Induced ovulation of small dominant follicles (< 12 mm) was associated with reduced pregnancy rates and increased late embryonic/fetal loss in beef cows. Factors affecting ovulatory follicle size following follicular wave synchrony remain unclear. The objective of the present study was to determine factors affecting ovulatory follicle size among suckled, postpartum anestrous beef cows. Follicular waves of anestrous beef cows (n = 55) were synchronized with GnRH1 on d -9, and PG on d -2, with (n = 26) or without (n = 29) an exogenous progesterone insert (CIDR) from GnRH1 to PG. Ovulation was induced 48 h after PG with GnRH2 and ovulatory follicle diameter was recorded. Ovulatory response to GnRH1 (Ov1+/Ov1-) and CIDR treatment (CIDR+/CIDR-) resulted in a 2 x 2 factorial design with 9, 17, 11, and 18 cows in the Ov1+/CIDR+, Ov1-/CIDR+, Ov1+/CIDR-, and Ov1-/CIDR- groups, respectively. There was no difference (P > 0.05) in the proportion of Ov1+ (16/20; 80%) and Ov1- (23/35; 66%) cows ovulating at GnRH2, nor was there a difference (P > 0.05) in the proportion of CIDR+ (19/26; 73%) and CIDR- (20/29; 69%) cows that ovulated at GnRH2. There was no interaction (P > 0.05) of ovulation and CIDR treatment on the proportion of cows ovulating to GnRH2 (7/9, 12/17, 9/11, and 11/18 of the Ov1+/CIDR+, Ov1-/CIDR+, Ov1+/CIDR-, and Ov1-/CIDR- treated cows, respectively). Ovulatory follicle diameter at GnRH2 was larger (P < 0.05) in Ov1+ cows (12.3 mm) than Ov1- cows (11.0 mm), but not different (P > 0.05) between CIDR+ (11.8 mm) and CIDR- (11.2 mm) cows. In summary, neither ovulation to GnRH1 nor CIDR administration affected the proportion of cows ovulating to GnRH2. Additionally ovulation to GnRH1, but not CIDR treatment resulted in ovulation of a larger follicle at GnRH2 among suckled, postpartum anestrous beef cows.

Key Words: Beef Cows, Ovulatory Follicle Size, Fertility

117 Comparison of protocols to synchronize estrus and ovulation I: Estrous cycling beef heifers. N. R. Leitman*, D. C. Busch, J. F. Bader, D. J. Wilson, M. R. Ellersieck, M. F. Smith, and D. J. Patterson, *University of Missouri*, *Columbia*.

The experiment compared estrous response, and synchrony of estrus and ovulation in estrous cycling beef heifers treated with one of four estrus synchronization protocols. Estrous cycling heifers were randomly assigned to one of four treatments (n=12 per treatment) by age and weight. Blood samples were collected 10 and 1 d prior to treatment initiation to confirm estrous cyclicity status (progesterone ≥ 0.5 ng/mL). Heifers assigned to CIDR Select (T1) received a CIDR insert (1.38 g progesterone) from d 0 to 14 followed by GnRH (100 µg Cystorelin) on d 23 and PG (25 mg Lutalyse) on d 30. Heifers assigned to Select-Synch + CIDR (T2) received a CIDR insert and GnRH on d 23 and PG at CIDR removal on d 30. Heifers assigned to CIDR-PG (T3) received a CIDR insert on d 23 and PG at CIDR removal on d 30. Heifers assigned to Select-Synch (T4) received GnRH on d 23 and PG on d 30. Heifers were fitted with HeatWatch® transmitters at the time of CIDR removal (T1, T2, and T3) or at GnRH (T4) for continuous estrus detection. Ovaries were scanned by ultrasonography on d 22, 23, and 25 to determine response to GnRH, and daily from d 30 to estrus. Beginning 20 h after the onset of standing estrus, ovaries were scanned every 4 h until ovulation. There was no difference (P > 0.05) in ovulatory response to GnRH (75, 42, and 75%; T1, T2, and T4, respectively) or estrous response (92, 100, 100, and 75%; T1, T2, T3, and T4, respectively). Variance for interval to estrus after PG differed (P < 0.002) between T1 and T2, and (P < 0.05) T1 and T4. Mean ‡SE intervals to estrus were 52 ‡ 3.7, 49 ‡ 3.5, 51 ‡ 3.5, and 48 ‡ 4.1 h for T1, T2, T3, and T4, respectively. Variance for interval to ovulation after PG differed (P < 0.05) among T1 and each of the other treatments. Mean intervals to ovulation were 83 ‡ 3.9, 80 ‡ 3.9, 81 ‡ 3.7, and 77 ‡ 4.3 h for T1, T2, T3, and T4, respectively. These smaller variances, for interval to estrus and ovulation, among CIDR Select treated heifers resulted in a significant improvement in synchrony of estrus and ovulation compared with the other three treatments.

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Key Words: Progestin, Estrus Synchronization, Beef Heifer

118 Comparison of protocols to synchronize estrus and ovulation II: Prepubertal beef heifers. N. R. Leitman*, D. C. Busch, J. F. Bader, D. J. Wilson, M. R. Ellersieck, M. F. Smith, and D. J. Patterson, *University of Missouri*, *Columbia*.

The experiment compared estrous response, and synchrony of estrus and ovulation in prepubertal beef heifers treated with one of two CIDR-based estrus synchronization protocols. Prepubertal beef heifers were assigned to one of two treatments by age and weight. Blood samples were collected 10 and 1 d prior to treatment initiation to confirm estrous cyclicity status (progesterone < 0.5 ng/mL). Heifers assigned to CIDR Select (n=14; T1) received a CIDR insert (1.38 g progesterone) from d 0 to 14 followed by GnRH (100 µg Cystorelin) on d 23 and PG (25 mg Lutalyse) on d 30. Heifers assigned to Select-Synch + CIDR (n=11; T2) received a CIDR insert and GnRH on d 23 and PG at CIDR removal on d 30. Heifers were fitted with HeatWatch® transmitters at the time of CIDR removal for continuous estrus detection. Ovaries were scanned by ultrasonography on d 22, 23, and 25 to determine ovulatory response to GnRH, and daily from d 30 to estrus. Beginning 20 h after the onset of estrus, ovaries were scanned every 4 h until ovulation. More (P = 0.02) T1 heifers responded to GnRH than T2 heifers (86% T1; 36% T2). There was no difference (P > 0.05) in estrous response, or in the interval from PG to estrus or ovulation. In summary, there was no difference between treatments in the variances for interval to estrus or ovulation among prepubertal heifers. Results from a concurrent experiment (See Leitman et al., 2007; Experiment I) were analyzed with these data to compare these two treatments among mixed groups of estrous cycling and prepubertal beef heifers. Response to GnRH (P < 0.01; 81% T1 and 39% T2), and the variances for interval to estrus and ovulation were smaller (P < 0.01) for T1 than T2. After results for the two treatments (prepubertal and estrous cycling) were combined, the CIDR Select protocol improved (P < 0.01) synchrony of estrus and ovulation compared with the Select Synch + CIDR protocol. These data suggest that the CIDR Select protocol may facilitate fixed-time AI more effectively in mixed groups of estrous cycling and prepubertal heifers.

This research was supported by USDA-NRI grant 2005-55203-15750.

Key Words: Progestin, Estrus Synchronization, Beef Heifer

119 Pregnancy rates following fixed-time AI in beef heifers after administration of CIDR-based protocols to synchronize estrus and ovulation. D. C. Busch*[1], D. J. Wilson[1], D. J. Schafer[2], N. R. Leitman[1], J. K. Hadek[2], M. R. Ellersieck[1], M. F. Smith[1], and D. J. Patterson[1], [1]*University of Missouri*, *Columbia*, [2]*MFA Inc.*, *Columbia, MO*.

Pregnancy rates after fixed-time AI (FTAI) were compared in beef heifers following administration of two CIDR-based protocols. The objective was to determine if long term progesterone treatment prior to a GnRH-prostaglandin $F_{2\alpha}$ (PG) regimen would improve estrous response and FTAI pregnancy rates compared to a CO-Synch + CIDR protocol. Heifers at three locations (n = 78, 61, 78) were assigned to one of two treatments by reproductive tract score (RTS; 1 to 5, 1 = immature, and 5 = cycling) age, and weight. Heifers assigned to treatment 1 (CIDR Select) received an EAZI-BREED™ CIDR® insert (CIDR; 1.38 g progesterone) from d 0 to 14 followed by GnRH (100 µg, i.m. Cystorelin) 9 d after CIDR removal (d 23) and PG (25 mg, i.m. Lutalyse) 7 d after GnRH treatment (d 30). Heifers assigned to treatment 2 (CO-Synch + CIDR) were injected with GnRH and equipped with a CIDR insert on d 23 and PG was injected and CIDR removed on d 30. Heifers at location 1 were fitted with HeatWatch® transmitters at PG until 24 d after FTAI to allow for continuous estrus detection. FTAI was performed at predetermined fixed-times for heifers in both treatments at 72 or 54 h after PG for the CIDR Select and CO-Synch + CIDR groups, respectively. All heifers were injected with GnRH at AI. Blood samples were collected 10 d before and immediately prior to treatment initiation (d 0) to determine pre-treatment estrous cyclicity (progesterone ≥ 0.5 ng/mL). At Location 1, estrous response during the synchronized period was higher (P = 0.06; 87 vs. 69%, respectively) and the variance for interval to estrus after PG was reduced among CIDR Select (P < 0.01) versus CO-Synch + CIDR treated heifers. FTAI pregnancy rates were higher (P = 0.02) following the CIDR Select protocol (62%) compared to the CO-Synch + CIDR protocol (47%). In summary, the CIDR Select protocol resulted in a higher and more synchronized estrous response and significantly higher FTAI pregnancy rates compared to the CO-Synch + CIDR protocol.

This research was supported by USDA-NRI grant 2005-55203-15750, and Select Sires, Inc.

Key Words: Artificial Insemination, Beef Heifers, Estrus Synchronization

120 Timing of fixed-time AI in beef cows following the CO-Synch + CIDR protocol. D. C. Busch*[1], D. J. Schafer[2], N. R. Leitman[1], D. J. Wilson[1], J. K. Haden[2], M. F. Smith[1], and D. J. Patterson[1], [1]*University of Missouri*, *Columbia*, [2]*MFA Inc.*, *Columbia, MO*.

The objective was to compare pregnancy rates in postpartum beef cows to fixed-time AI (FTAI) after administration of the CO-Synch + CIDR protocol. Cows (n = 435) at two locations (n = 210, 225) were stratified by age, BCS and days postpartum (DPP) to one of two FTAI intervals. Cows assigned to CO-Synch + CIDR were injected with GnRH (100 µg, i.m. Cystorelin) and equipped with an EAZI-BREED™ CIDR® insert (CIDR, 1.38g progesterone, d 0). CIDR inserts were removed 7 d later at the time PG (25 mg i.m. Lutalyse) was administered (d 7). Continuous estrus detection was performed at Location 1 using HeatWatch®. Transmitters were fitted at the time of PG and removed at the time of AI. Artificial insemination was performed at predetermined fixed-times [54 h (TAI 54; n = 216) or 66 h (TAI 66; n = 219) after PG] and all cows were injected with GnRH (100 µg, i.m. Cystorelin) at AI. Blood samples were collected 10 d and 1 d prior to treatment initiation to determine pre-treatment estrous cyclicity [progesterone ≥ 0.5 ng/ml; (TAI 54, 170/216, 79%; TAI 66, 177/219, 81%); P=0.45]. At Location 1, more cows exhibited estrus prior to TAI 66 than TAI 54 (P = 0.02; 46/106, 43% and 28/104, 27%, respectively). Pregnancy rates were higher (P < 0.01) among cows that exhibited estrus than for those that did not (60/74, 81% and 71/135, 53%, respectively). There were no treatment by location interactions (P > 0.10) for age, DPP, or BCS, thus the results were pooled for the respective treatments. Pregnancy rates resulting from fixed-time AI did not differ between treatments [P = 0.20; (TAI 54, 126/215, 59%; TAI 66 141/219, 64%)], among sires (P = 0.13) or technicians (P = 0.15). However, when only considering cows ≥ 3 year of age, significantly more cows conceived to the FTAI when AI was performed at 66 h compared to 54 h (118/167, 71% and 96/163, 59%, respectively). There was no difference between FTAI pregnancy rates based on pre-treatment estrous cyclicity status (P = 0.12), and no difference (P = 0.53) between treatments in final pregnancy rates. In summary, cow age group should be considered when recommending timing for FTAI following the CO-Synch + CIDR protocol.

Key Words: Artificial Insemination, Estrus Synchronization

121 Comparison of the 7-11 estrous synchronization protocol between suckled Angus (AN) and Brangus (BN) cows. R. D. Esterman*, B. R. Austin, S. A. Woodall, and J. V. Yelich, *University of Florida*, *Gainesville*.

Suckled AN (n=44) and BN (n=38) cows were used to evaluate the effectiveness of GnRH to initiate ovulation when given 4 d after a 7 d melengestrol acetate (MGA) treatment and to eventually synchronize estrus. Mean BW, days postpartum, and body condition score (Scale 1-9) for AN and BN were 488 ± 10 and 514 ± 11 kg, 63.1 ± 3.7 and 57.4 ± 4.0 d , and 5.5 ± 0.8 and 5.6 ± 0.8, respectively. Start of experiment was d 0 and blood samples were collected on d -12 and -2 to determine estrous cycling status by measuring blood progesterone (P). On d 0, MGA (0.5 mg/head/d) treatment was started with prostaglandin F2α (PG1; Lutalyse®) on d 7 followed by GnRH (100 µg; Cystorelin®) on d 11. On d 18, PG (PG2) was administered and estrus was detected for 5 d with HeatWatch®, followed by AI 8 to 12 h after the onset of estrus. On d 0, 7, 11, and 18, blood samples were collected to evaluate P. Three groups of cows were used to evaluate ovarian function via ultrasonography on d 7, 11, 13, and 18, including anestrus (low P, < 1 ng/mL, d -12 and -2; ANEST; AN=6, BN=6), estrous cycling with low P on d -12 and high P (> 1 ng/mL) on d -2 (CYCH; AN=6, BN=6), and estrous cycling with high P on d -2 with PG on d 0 to mimic a low P environment during MGA (CYCL; AN=6, BN=6). Ovulation rate and size of follicle ovulating to GnRH were similar (P > 0.05) for AN (17/18=94.4%; 16.9 ± 0.8 mm) and BN (17/18=94.4%; 17.7 ± 0.8 mm), respectively. Size of follicle ovulating to GnRH tended (P = 0.09) to be greater for CYCL (18.6 ± 0.9 mm) and ANEST

(17.7 ± 0.9 mm) compared to CYCH (15.8 ± 0.9 mm). Largest follicle at PG2 (13.3 ± 0.3 mm) was similar (P > 0.05) for scan group, breed, and scan group × breed. Luteolysis tended (P = 0.09) to be greater for AN (39/41=95.1%) compared to BN (31/37=83.8%). Estrous (70.5, 65.8%), conception (67.7, 76.0%), and synchronized pregnancy rates (47.7, 50.0%) were similar (P > 0.05) for AN and BN, respectively. In conclusion, suckled AN and BN cows responded similarly to the 7-11 synchronization protocol.

Key Words: Estrous Synchronization, GnRH, PG

122 The use of estrus synchronization, resynchronization, and ultrasound to facilitate two timed artificial inseminations without heat detection in beef cattle. W. E. Beal*, M. D. Utt, and T. E. Wiseman, *Virginia Polytechnic Institute and State University*, *Blacksburg*.

The objective was to evaluate the use of AI after synchronization and resynchronization of estrus without heat detection. Angus cows (n=37) or heifers (n=22) received GnRH (100 µg, i.m.) and an intravaginal progesterone-releasing device (CIDR). The CIDR remained in place for 7 d. Animals received 25 mg of $PGF_2\alpha$ (PG; i.m.) at CIDR removal. The control group (C; n=28) was observed for estrus and bred 12 h after estrus detection. The timed AI group (TAI; n=31) was inseminated and received GnRH 64 h after CIDR removal. Animals in both groups were fitted with a used CIDR 13 d after TAI. The used CIDR was removed after 7 d. Following removal of the used CIDR, C animals not detected in estrus after the first CIDR received an injection of PG. Animals in the C group were inseminated 12 h after estrus detection. Sixty-four hours after removal of the used CIDR, pregnancy was diagnosed by ultrasonography (Aloka 500V) in the TAI group. Non-pregnant animals in the TAI group were inseminated and received GnRH. At the time of the first or second AI, the maximum diameter and estimated blood flow serving the ovulatory follicle were determined by B-mode and color-flow Doppler ultrasonography (Aloka 3500V). Pregnancy diagnosis was performed 30 d after the last AI. Pregnancy rate following the removal of the first CIDR did not differ (P=.10) between C (14/28; 50%) and TAI (22/31; 71%). Final pregnancy rates were 19/28 (68%) and 27/31 (89%) in the C and TAI groups, respectively (P=.08). Mean diameter of the ovulatory follicle (15.6 ± .34 mm) did not differ between treatment groups. However, blood flow to the ovulatory follicle was greater (P<.02) in C than in TAI animals. This method of AI after synchronization and resynchronization of estrus without heat detection resulted in pregnancy rates similar to those achieved when AI was performed after heat detection.

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Key Words: Estrus Synchronization, Timed AI, Beef Cattle

123 Effect of GnRH at time of insemination on initiation of LH pulses and subsequent progesterone. S. D. Fields*, B. L. Perry, and G. A. Perry, *South Dakota State University*, *Brookings*.

Research has indicated that LH pulses play a vital role in CL formation and subsequent progesterone concentrations. Therefore, our objectives were to determine when LH pulses begin following onset of estrus, what effect an injection of GnRH would have on initiation of LH pulses, and what effect LH pulse initiation had on subsequent progesterone concentrations. Cows were synchronized with the Select Synch+CIDR protocol (d -7 100 µg GnRH and CIDR; d 0 25 mg PG and removal of CIDR; estrus detected with HeatWatch). Following detection in estrus, a jugular catheter was inserted in each cow (n = 10). Based on initiation of estrus, cows were allotted into two treatments: 1) GnRH given 12 h (12.5 ± 1.2 h) after the initiation of estrus (n = 5; 100 µg) and 2) Control (n = 5). Blood samples were collected at 15-min intervals for 6 h at 12 h (bleed 1), 26 h (bleed 2), 40 h (bleed 3), 54 h (bleed 4), and 68 h (bleed 5) after the onset of estrus. Interval from onset of estrus to bleed 1 and ovulation was similar between treatments ($P = 0.80$). GnRH cows tended ($P = 0.08$) to have a greater area under the LH curve for bleed 1 compared to Control. No differences were detected ($P > 0.47$) in bleeds 2, 3, 4, or 5. Average concentration of LH for GnRH cows in bleed 1 tended ($P = 0.07$) to be greater than control. No differences were detected ($P > 0.53$) in bleeds 2, 3, 4, or 5. No differences ($P > 0.31$) were detected in pulse frequency between treatments in bleeds 1, 3, 4, or 5, but in bleed 2, Control tended ($P = 0.095$) to have more pulses than GnRH (2.5 ± 0.5 vs 1.4 ± 0.4, respectively). GnRH treated cows tended ($P = 0.07$) to have greater subsequent progesterone concentrations; however, GnRH-treated cows that had no LH pulses during bleed 2 had lower ($P = 0.02$) progesterone concentrations than cows with pulses (Control or GnRH). In summary, injecting cows with GnRH approximately 12 h after the onset of estrus tended to reduce LH pulses 26–32 h following initiation of estrus, and elimination of LH pulses between 26–32 h resulted in decreased concentrations of progesterone during the subsequent cycle.

Key Words: LH, GnRH, Progesterone

124 Effect of pretreatment with prostaglandin $F_{2\alpha}$ 12 days before initiation of Resynch on fertility of lactating dairy cows. E. Silva*[1], R. A. Sterry[1], D. Kolb[2], M. C. Wiltbank[1], and P.M. Fricke[1], [1]*University of Wisconsin*, *Madison*, [2]*Lodi Veterinary Clinic*, *Lodi, WI.*

Our hypothesis was that pretreatment with $PGF_{2\alpha}$ (PGF) 12 d before initiation of Resynch would increase the number of cows with a CL at the first GnRH injection of Resynch thereby increasing fertility to Resynch. Lactating Holstein cows diagnosed not pregnant 31 d after their first postpartum timed AI (TAI; d 0) were randomly assigned by parity to receive each of two resynchronization treatments as follows: 1) RES (n=255), GnRH (d 32), PGF (d 39), GnRH 54 h after PGF, or 2) PGF+RES (n=272), PGF (d 34), GnRH (d 46), PGF (d 53), GnRH 54 h after PGF. All cows received TAI 16 h after the last GnRH injection, and cows failing to conceive to first Resynch TAI remained in the same treatment for a second Resynch TAI. Blood samples were collected from all cows at the first GnRH injection of Resynch to determine luteal status based on serum progesterone (P4). Fertility to first postpartum TAI 31 d after Presynch+Ovsynch was 37.0 % (n=836). Overall, PGF+RES cows had more P/AI 31 d (38.5 vs. 31.1 %; P=0.06) and 66 d (35.2 vs. 25.6 %; P=0.01) after TAI and fewer pregnancy losses from 31 to 66 d (7.6 vs. 17.1 %, P=0.04) after TAI than RES cows. Although cows with low P4 at initiation of Resynch had fewer P/AI 31 d (25.0 vs. 37.8 %, P=0.008) and 66 d (20.3 vs. 33.2 %, P=0.005) after TAI than cows with high P4, pretreatment with PGF did not affect the number of cows with high P4 at initiation of Resynch (76.1 vs. 73.1 for RES vs. PGF+RES cows, respectively) which was inconsistent with our hypothesis. In conclusion, although pretreatment with PGF resulted in more P/AI at 66 d after TAI than traditional Resynch due to both more P/AI at 31 d after TAI and reduced pregnancy

losses, this effect could not be attributed to increasing the number of cows with a CL at initiation of Resynch. Furthermore, PGF+RES cows had a 2 wk delay in the Resynch TAI compared to RES cows which would diminish the impact of improved fertility on 21-day pregnancy rate.

Key Words: Resynch, Prostaglandin F $_{2\alpha}$, Dairy Cows

125 Reducing the interval from Presynchronization to initiation of timed AI improves fertility in dairy cows. K. N. Galvao*, M. F. Sa Filho, and J. E.P. Santos, *School of Veterinary Medicine, University of California Davis*, *Tulare*.

Objectives were to determine if shortening the interval from presynchronization to the first GnRH (G1) in a Presynch/timed AI (TAI) protocol improves conception rate (CR). Holstein cows, 1214, at 37±3 d in milk (DIM) were stratified by parity, DIM, and milk yield, and randomly assigned to: PShort (n = 410), two injections of PGF2a (PG) at 40 and 54 DIM, then enrolled in a TAI 11 d later; PShortG (n = 392), same as PShort, but with an injection of GnRH 7 d before G1; Control (n = 412), two injections of PG at 37 and 51 DIM, then enrolled in a TAI 14 d later. All cows received the same TAI protocol (d 65, G1; d 72, PG; d 73, 1 mg of ECP; d 75, TAI). A subset of 1000 cows had their ovaries scanned at 65 and 72 DIM, which coincided with injections of GnRH and PG of TAI, respectively, to determine CL and ovulation to G1. Pregnancy was diagnosed on d 38 and 65 after AI. Data were analyzed with pre-planned orthogonal contrasts to determine the effect of interval (PShort + PShortG vs. Control) and GnRH treatment (PShort vs. PShortG). Results are depicted in the following sequence: PShort, PShortG, and Control. Presence of a CL at G1 was not influenced (P=0.95) by interval, but GnRH increased (P<0.01) the proportion of cows with CL (74.2, 88.2, and 80.6%). Ovulation to G1 was greater (P<0.01) for the short interval compared with Control, but GnRH did not improve (P=0.28) ovulation (61.4, 62.2, and 44.7%). The increased ovulation to G1 was primarily caused by greater (P<0.01) ovulatory response in cows with a CL at G1 (54.4, 59.7, and 37.2%), but did not differ (P=0.64) for cows without a CL at G1. Treatment affected the CR on d 38, and was greater (P=0.04) for the short interval compared with Control, but addition of GnRH did not improve (P=0.19) CR (40.5, 39.8, and 33.5%). The same effects were observed for CR on d 65 after AI (36.7, 36.2, and 30.5%). Cows ovulating to G1 had greater (P<0.05) CR regardless if they had (42.2 vs. 37.7%) or not (27.6 vs. 15.4%) a CL at G1. Shortening the interval from presynchronization to initiation of TAI from 14 to 11 d increased ovulatory response and conception rates in dairy cows.

Key Words: Dairy Cow, Presynchronization, Reproduction

Production, Management & the Environment - Livestock and Poultry: Dairy Production and Management I

126 Effects of dim light at night on milk yield, milk composition and endocrine profile of lactating dairy cows. M. A. Bal*[1], G. B. Penner[1], M. Oba[1], and A. D. Kennedy[2], [1]*University of Alberta*, *Edmonton, AB, Canada*, [2]*University of Manitoba*, *Winnipeg, MB, Canada*.

Twenty-four multiparous lactating dairy cows (139 ± 34 DIM) were assigned to two different light intensities from 6 PM to 4 AM daily in a cross-over design with 28-d periods to evaluate the effect of night dim-light. It was hypothesized that night dim-light would increase milk production by decreasing melatonin concentration and increasing IGF-1 concentration in plasma. Light intensity during the day was approximately 200 lux and light treatments at night were 0-5 lux (CONTROL) and 40-60 lux (DIM LIGHT). Each group of animal (n=12) was placed on either the north or south side of the tie stall barn. Light intensity of the barn ranged from 40 to 60 lux at night but was reduced to < 5 lux for the CONTROL by placing black tarps near the light fixtures. Feed was offered in a TMR once daily at 9 AM. Blood samples for hormone analyses were taken every two hours at the last day of each period from 6 PM to 2 AM. There was no significant difference for milk, fat, protein, and lactose yields between CONTROL and DIM-LIGHT treatments, averaging 33.2, 1.04, 1.02, and 1.45 kg/d, respectively. Similarly, milk fat and protein concentrations were not affected by treatment. Concentration of lactose was significantly higher ($P < 0.01$) for DIM LIGHT than CONTROL (4.42% vs. 4.38%). Plasma prolactin concentration at 6 PM (during day-time) tended to be higher ($P = 0.07$) for DIM-LIGHT (15.1 ng/ml) than CONTROL (11.4 ng/ml). No change in prolactin was seen from 6 PM to 10 PM with DIM-LIGHT, but it increased 61% from 6 PM (11.4 ng/ml) to 10 PM (18.7 ng/ml) with CONTROL. Plasma IGF-1 concentration was not affected by treatment at 6 PM (123.1 ng/ml) or 10 PM (127.1 ng/ml). Day-time (6 PM) plasma melatonin concentration was relatively high (10.3 pg/ml). Treatment had no effect on the night-time plateau in melatonin found at 10 PM (21.5 pg/ml) and 12 AM (19.8 pg/ml). These data indicate that night dim-light (40-60 lux) modified the natural diurnal rhythm in plasma prolactin but not melatonin, and had a positive effect on milk lactose concentration but not yield.

Key Words: Dim Light, Milk Production, Melatonin and Prolactin

127 Effects of dairy dry lot corral management on air emissions. L. M. Nuckles* and F. M. Mitloehner, *University of California*, *Davis*.

The objective of this study was to evaluate the effects of drylot corral waste management on emissions of smog-forming compounds and greenhouse gases. The San Joaquin Valley of California is the leading dairy region of the United States but also known as the worst non-attainment area for smog. A total of 96 Holstein dry cows were housed in four, totally enclosed cattle pen enclosures (CPEs) and were fed a TMR *ad libitum*. Eight cows were housed in each of the four CPEs during each of three, 14 day replications. The experimental design was a CRD. Cows were randomly sorted into four groups and stratified by weight. Treatments were (1) control, manure accumulated for 14 days (CON), (2) acidifier surface application (sodium bisulfate, SBS), (3) frequent harrowing (HAR), and (4) scraping (SCR). Emissions of the smog-forming alcohols ethanol (EtOH) and methanol (MeOH) as well as the greenhouse gases (GHG) carbon dioxide (CO_2), nitrous oxide (N_2O), and methane (CH_4) were measured continuously from the CPEs′ air inlets and outlets. Gaseous concentrations were sampled using a photoacoustic gas-analyzer (INNOVA 1412) and emission rates (kg/cow/yr) calculated. Data were analyzed using Proc MIXED procedures in SAS. Overall, alcohol emissions for SBS were lower ($P < 0.05$) compared to all other treatments. EtOH emission rates

for SBS, CON, HAR, and SCR were 1.54, 7.8, 8.9, and 7.8 kg/cow/yr, respectively. MeOH, emission rates for SBS, CON, HAR, and SCR were 3.4, 10.3, 12.2, and 10.8 kg/cow/yr, respectively. SCR compared to SBS, CON, HAR showed reduced ($P < 0.05$) emission rates for N_2O, CO_2, and CH_4. Emission rates for CH_4 and N_2O were higher in SBS ($P < 0.05$), while CO_2 emission rates were lower compared to the other treatments ($P < 0.05$). This study suggests that surface acidifier (SBS) applied to dairy drylot corrals can reduce alcohol emissions, thus lowering resulting smog pollution. Surface acidifiers have inconclusive effects on GHG emissions. Scraping and harrowing of corral surface manure show little promise to reduce emissions of both smog forming compounds and greenhouse gases from dairies.

Key Words: Waste, Greenhouse Gases, Alcohols

128 Characterization and quantification of emissions from dairies. N. M. Marcillac*[1], F. M. Schwander[1], R. F. Follett[1], J. L. Collett[2], and N. P. Hanan[1], [1]*Colorado State University*, *Fort Collins*, [2]*USDA/ARS*, *Fort Collins, CO*.

Animal agriculture is a major source of atmospheric pollutants, but the nature and dispersion of those pollutants is not well known. This study aimed at quantifying emissions of ammonia (NH3), ammonium (NH4), nitric acid (HNO3), PM2.5, methane (CH4), carbon dioxide (CO2), and nitrous oxide (N2O) from dairy systems, and characterizing the spatial, diurnal, and seasonal variability of those emissions. Using a unique mobile sampling methodology employing helium balloons, filter packs, syringe pumps and a tethersonde climate sampling system, gases and particulates were measured at five heights (2 to 40 m high) at three locations downwind and one location upwind of a dairy. This innovative technique provided a spatially resolved characterization of the emission plume. Measurements were made at two dairies, seasonally, over two years from summer 2005 to winter 2006. Preliminary results show that the concentration of each compound varies spatially with height and has a strong seasonal variability. HNO3 had an inverse concentration to NH4 and typically was lower in downwind air, indicating consumption by conversion to ammonium nitrate. NH3 had a large differential from the upwind concentration ($P < 0.05$), especially in the summer months, and indicated a strong source from the dairy. The differential concentration of CH4 was greater than the other greenhouse gases ($P < 0.05$), while N2O and CO2 had very small contributions to total emissions. Peak concentrations were found at or near ground level ($P < 0.05$) with differentials 2 to 3 times greater than the upper heights, reflecting a strong local source. This data is helpful in characterizing the emission plume from dairies, aiding scientists and regulators in better understanding emissions from dairy operations.

Key Words: Dairy Emissions, Ammonia, Greenhouse Gases

129 Effects of waste management techniques to reduce dairy emissions from freestall housing. M. S. Calvo*, K. R. Stackhouse, and F. M. Mitloehner, *University of California*, *Davis*.

The objective of this study was to reduce smog-forming and green house gas emissions (GHG) from lactating Holstein cows using industry typical freestall waste management. The San Joaquin Valley (SJV) in Central California is the largest milk producing region in the United States. The valley suffers from substantial smog forming gases (aka Volatile Organic Compounds, VOC), and GHG emissions. Typical dairy freestall waste management in the SJV includes flushing and scraping. In the present study, four treatments were compared in groups of three cows/group. A total of nine lactating Holstein cows were randomly assigned into three groups and each group underwent all treatments using a CRD. The four treatments were 1) no waste removal (CON), 2) flushing three times daily (FL3), 3) flushing six times daily (FL6), and 4) scraping three times daily (SC3). Cows were fed a TMR *ad libitum* and housed in freestalls that were located inside an environmental chamber. VOC and GHG emission concentrations were measured using a photo acoustic gas analyzer (INNOVA 1412). Emission rates were calculated in kg/cow/year and analyzed using PROC MIXED in SAS. All emission compounds showed differences across treatments. As a general trend, CON showed highest emissions ($P < 0.05$), followed by SC3, FL3, and FL6. Flush vs. dry waste removal techniques (flushing vs. scraping) is approximately twice as effective ($P < 0.05$) in reducing VOC emissions under freestall conditions. More frequent flushing of dairy waste (FL6 vs. FL3) leads to further reduction of VOC emissions. GHG emissions were similar across treatments. The results of this study indicate that waste removal techniques used on modern dairies can decrease dairy air emissions. Consequently, VOC and GHG that promote smog and climate change can be reduced effectively through management of cow housing.

Key Words: Dairy, Waste, Emissions

130 Nitrogen losses from dairy manure estimated through nitrogen mass balance or using markers. A. N. Hristov*[1], S. Zaman[1], M. Vander Pol[1], P. Ndegwa[2], S. Silva[3], and C. Kendall[2], [1]*University of Idaho*, *Moscow*, [2]*Washington State University*, *Pullman*, [3]*U.S. Geological Survey*, *Menlo Park, CA*.

The objective of this study was to estimate N losses from dairy manure using N mass balance and other indirect approaches. The study was conducted at the University of Idaho Dairy Center, which is a free-stall facility with scraping system for manure removal. The study was conducted with one pen of 18 lactating Holstein cows. The duration of the trial was 30 d. Manure was scraped and removed from the pen once daily. Feed delivered and milk yields were recorded daily. The amount of manure removed from the pen was recorded daily and samples were collected for analyses, 24 h after excretion. Grab fecal and spot urine samples were colleted weekly from each cow. Output of urine and feces was estimated using acid-insoluble ash and creatinine as markers. Feces, urine, and manure samples were analyzed for N, ^{15}N, P, Cu, and Ca. Average daily N input with feed was 12.9±0.10 kg, or 385.8 kg for the duration of the trial. Average milk yield per cow was 37±0.2 kg/d with 3.9±0.08% crude protein content. Total N secreted with milk was 100.5 kg. Excretion of N with feces and urine was estimated at 224.3 kg. Manure N collected from the pen during the trial was 134.3 kg. Thus, 40% of the N excreted by the cows could not be accounted for in manure removed from the pen 24 h after excretion. Using N:P, N:Cu, and N:Ca ratios in fresh and 24-h manure, 60, 61, and 63% of the excreted N could not be accounted for. ^{15}N abundance of manure N increased in 24 h, from 1.344‰ to 4.887‰, presumably due to the loss of highly depleted in ^{15}N ammonia. Under the conditions in which this study was conducted (15.6±3.9°C; 2.3±1.0 m/s wind speed; and 72.6±12.5% RH), N losses from manure were high in the first 24 h after excretion. Data suggest that ratios of N to non-volatile elements and ^{15}N analyses may be useful in estimating N losses from cattle manure.

Key Words: Dairy Cow, Manure, Nitrogen Losses

131 Comparision of the Intergovernmental Panel on Climate Change (IPCC) system for estimating methane emission from dairy cows. S. K. Nes*, H. Volden, and S. J. Krizsan, *Norwegian University of Life Sciences*, *Ås, Norway*.

The objective of this study was to compare IPCC (2001) guidelines for estimating CH_4 emission by using a more advanced model, which include information on diet composition and animal production level. The IPCC has a 2-tiered system for estimating emission from enteric fermentation. Tier 1 is a simplified approach based on a fixed emission factor (EF) for each animal category. Until 2006 Norwegian calculations have been based on Tier 1. Tier 2 is a more complex approach where EF is developed based on country-specific data as nutrient requirements and feed intake. However, the IPCC has recommended using more advanced methods that goes beyond the Tier 2. About 90 % of the dairy cows in Norway are registered in the Cow Recording System (CRS), which contains detailed information regarding annual milk production and proportion of concentrate in the diet. Information from 1.16 million observations was used to calculate standard lactation curves and feed rations at different yields, feed intake, forage quality and forage:concentrate ratio. Using these data simulations average values of CH_4 production was calculated from 2 equations (Kirchgessner et al., 2005; Mills et al., 2003). Moreover, 2 multiple regression equations were developed where proportion of feed concentrate and milk yield were the only variables used to predict intake of GE and CH_4 conversion rate. to compare different methods CH_4 emission (kg/head per year) was calculated at 5000 (LP) and 9000 (HP) kg milk/year and at 2 levels of concentrate: 20% (LC) and 50% (HC). Estimated emission was constant regardless of level of yield and concentrate with Tier 1. Within LP and HP, Tier 2 and Tier 3 estimated 107 and 150, and 135 and 153 kg, respectively. There was no difference in estimating emission between LC and HC according to Tier 2. However, Tier 3 predicted higher emission at LC and HC at both yields but the difference was more pronounced at HP.

Key Words: Concentrate Level, Methane Emission, Milk Yield

132 Prediction of DHI udder health values from bulk tank information. A. J. Young*[1] and S. P. Tripp[2], [1]*Utah State University*, *Logan*, [2]*DHI-Provo Computing Service*, *Provo, UT*.

Identifying and predicting udder health problems are easily accomplished using DHIA information. However, many herds are not on DHI or experience problems between tests. The objective of this study was to determine if bulk tank somatic cell information could be used to predict potential udder problems and milk loss. DHI test information was collected from 17 dairies (13 Utah, 2 Idaho, 1 Montana and 1 Nevada) from January 2004 to December 2006. Bulk tank milk values were also collected and matched with test day information. After editing, 449 individual test days were used in the analysis. The bulk tank average SCS for the dataset was 4.19 with a range of 1.45 to 6.46. Correlation between DHI and bulk tank SCC and somatic cell score (SCS) were 0.842 and 0.898, respectively. Correlations with bulk tank SCS and the percent low (0-4), medium (5-6) and high (7-9) SCS from DHI were -0.834, 0.712 and 0.827, respectively. Linear and quadratic equations were developed using proc mixed models to predict percentage of cows in each of the SCS categories from bulk tank milk SCS. Both equations gave similar results for SCS of 3, 4 and 5 (range of differences was -0.6% to 0.37%). However, for SCS of 6, the quadratic equation predicted a higher percentage (+2.76%) of cows in the high category than the linear equation. Proc mixed results suggest that the quadratic equation was a better model than the linear. Several equations predicting milk loss percentage based on bulk tank SCS or SCC were found in the literature. Linear and quadratic equations were developed using milk loss percentage for each equation compared with bulk tank SCS. Using linear equations, the average milk loss for a bulk tank SCS of 3, 4, 5 and 6, was 0.94, 3.29, 5.65 and 8.0%, respectively. Using quadratic equations, the average milk loss based on a bulk tank SCS of 3, 4, 5 and 6, were 1.24, 2.84, 5.77 and 10.03%, respectively. We conclude that in the absence of DHI information, bulk tank SCS can closely predict values expected from DHI in terms of percent cows with high, medium or low SCS and percent milk loss.

Key Words: DHI, Bulk Tank, SCS

133 Variance components of test-day milk, milk components, and somatic cell score useful for management advice. M. Caccamo*[1], R. F. Veerkamp[2], G. de Jong[3], M. H. Pool[2], R. Petriglieri[1], G. Azzaro[1], and G. Licitra[1,4], [1]*CoRFiLaC, Regione Siciliana*, *Ragusa, Italy*, [2]*Animal Breeding and Genomics Center, ASG, WageningenUR*, *Lelystad, The Netherlands*, [3]*NRS*, *Arnhem, The Netherlands*, [4]*D.A.C.P.A. University of Catania*, *Italy*.

Test-day (TD) models are used worldwide to perform national genetic evaluations for dairy cattle. TD models estimate (changes in) lactation curves, and variation around typical population or herd lactation curves, after adjustment for fixed effects and removal of environmental effects. Although potentially useful, little attention has been put on application of TD models for management purposes. The aim of this study was to estimate variance components for milk, milk components, and somatic cell score of dairy cows in Ragusa and Vicenza area, focusing on those variance components that are potentially useful for management advice to dairy farmers. Non informative records were extruded and the final dataset comprised 1,080,637 test-day records from 42,817 cows on 471 herds. Variance components were estimated using the multi-lactation, random regression, TD animal model adopted by NRS. The model comprised four fixed effects and a random herd × test date (HTD) effect. Random regressions were included for herd curve (HCUR), animal additive genetic effect, and permanent environment, using fourth-order Legendre polynomials. HCUR variances for milk and protein production were highest around the production peak (DIM 50 - 150), whereas for fat production the HCUR variance was relatively constant in lactation 1 and decreasing after a peak around 40 - 90 DIM throughout lactations 2 and 3. For SCS, the HCUR variances were relatively small compared to the other variance components. For all the traits except SCS the HTD variance was much lower than the HCUR variances and HCUR over phenotypic variances had a peak around 50-150 DIM and decreased at the end of the lactation to about 0.15 except for the first lactation where they slightly decreased to 0.35. Results for HCUR and HTD variance indicate that the development of management parameters should focus on between herd parameters during peak lactation for milk and milk components. For SCS the within herds variance components were higher than the between herds variance suggesting that focus should be on management parameters explaining variances at cow level.

Key Words: Dairy Cattle, Test-Day Production, Management Curves

134 Waste milk supply and pasteurizer performance on California dairy farms and calf ranches. M. C. Scott, R. E. James*, and M. L. McGilliard, *Virginia Polytechnic Institute and State University*, *Blacksburg, VA*.

Waste milk (WM) can be an economical and viable source of nutrition for young calves, but feeding it raw poses biosecurity concerns. Pasteurization effectively reduces health risk associated with feeding WM. This study was to track effectiveness of on-farm pasteurizers and determine amount and composition of WM generated by 9 dairy farms and used by a 30,000-head calf ranch in Tulare and Kings County, CA. Standard plate count (SPC), alkaline phosphatase, fat percentage, and protein percentage were measured prior to and immediately following pasteurization and at 20 min intervals until the last calf was fed. Farms ranging in size from 530 to 7000 milk cows were visited once in June 2005 and once in January 2006. There were 2 batch, 3 turbulent batch and 5 high temperature short time pasteurizers used on these operations. Standard plate count (SPC) of waste milk before pasteurization averaged 1.6 million cfu/ml, but ranged from 3,000 to 5.9 million cfu/ml. Fat and protein averaged 3.7% and 3.8%. However, fat varied from 1.1% to 5.3% and protein from 2.9% to 4.7%. Pasteurizer performance was evaluated based on SPC and alkaline phosphatase activity. Pasteurizers were effective, deactivating alkaline phosphatase more than 95% of the time, with post-pasteurized SPC averaging 13,000 cfu/ml. Farms using buckets to feed calves experienced higher SPC post pasteurization and during feeding than those using bottles. Five of nine dairies and the calf ranch added additional milk replacer to increase total solids of liquid feed, but only the calf ranch succeeded in increasing total solids. Most dairy farms had sufficient quantities of waste milk to meet the needs of the calf-feeding operation.

Key Words: Pasteurization, Calf, Waste Milk

135 Investigating relationship between protein-fat difference and milk yield of Iraninan Holstein dairy cows. B. Saremi*[1], J. Ghaseminejad[2], and J. Eslami[3], [1]*Education center of Jihad-e Agriculture, Animal Science Department*, *Khorasan Razavi, Mashhad, Iran*, [2]*Animal Science Department of Agricultural and Natural Resources University of Gorgan*, *Iran*, [3]*Animal Science Department of Zabol University*, *Iran*.

Aim of this study was investigating effects of protein-fat difference on milk production of Holstein dairy cows. Milk, fat, Protein and Somatic cell count (SCC) records from North, south and Razavi Khorasan states of Iran (59044 record) were adjusted using days in milk, parity, milking times, year and month of recording. Data was obtained from Jihad-e Agriculture Organization of Khorasan state of Iran, Animal Science section. Protein-fat difference was determined using fat and protein records based on grouping (cows were divided to 8 groups: protein fat differences Less than -1, -0.99 to -0.5, -0.49 to 0, 0.01 to 0.25, 0.26 to 0.50, 0.51 to 0.75, 0.76 to 1.00 and more than 1.01). Data were analyzed based on a completely randomized design. Means were compared using Duncan multiple range test (P<0.01). Results shows that protein fat difference can influence milk yield (P<0.01). Also it has a significant effect on SCC in milk (P<0.01). When milk fat is more than protein (negative groups), it shows that milk yield is lowest and gradually by decreasing fat content and constant amount of protein, milk yield increased (Negative relationship between milk yield and fat percent). When fat content is more than 0.5 percent below protein, again milk begins to reduce. At difference about 0.75, rate of milk reduction get higher. This difference between milk protein and fat is an indicator of acidosis. So 31.03 percent of records show cows that are influenced with one kind of acidosis in their rumen. It can adversely affect milk production as can be seen. SCC has a trend just like milk production, unless most SCC take place at protein fat difference about 0.51 to 0.75. According to these data it seems that efficient use of monthly records which usually exist in each herd are a suitable tool to investigate herd nutrition and may be a good indicator of distribution of acidosis in herds because of the high correlation.

Table and figure 1 Effect of protein fat difference on milk yield and somatic cell count of Holstein dairy cattle

Items	Grouping								
SEM	< -1.00	-0.99 to -0.5	-0.49 to 0	0.01 to 0.25	0.26 to 0.50	0.51 to 0.75	0.76 to 1.00	>1.00	
Milk (Kg)	25.63^{f}	25.97^{e}	26.86^{c}	27.94^{b}	28.95^{a}	28.90^{a}	28.15^{b}	26.58^{d}	0.032
SCC (x1000)	297^{f}	314^{e}	317de	325^{c}	322^{dc}	342^{a}	335^{b}	279^{g}	0.839

Means with different characters are significantly different (P<0.01)

Key Words: Protein Fat Difference, Milk Yield, Somatic Cell Count

136 Best management practices to improve milk quality and udder health in organically-managed dairy herds in Southeastern Pennsylvania. K. E. Griswold*[1], H. Karreman[2], and J. Mylin[3], [1]*The Pennsylvania State University Cooperative Extension*, *University Park*, [2]*Penn Dutch Cow Care*, *Gap, PA*, [3]*Lancaster DHIA*, *Manheim, PA*.

The effects of various management practices on milk quality and udder health in organically-managed (OM) dairy herds in Southeastern Pennsylvania were examined using a combination of survey and DHIA data. Initially, 38 OM herds using Lancaster DHIA services were recruited for the study, but only 29 herds returned completed surveys. The survey consisted of 308 questions concerning herd demographics, milk quality, health, reproduction, nutrition, and youngstock. The DHIA information included monthly 202 report data for 2006. Data were analyzed using PROC MIXED within SAS. The milking procedures model included the fixed effects of wearing gloves (WG), dry wiping (DW), pre-dipping (PRD), fore-stripping (FS), wiping dry prior to unit attachment (WD), and post-dipping (POD). The mastitis control practices model included the fixed effects of using California Mastitis Test (CMT), hand stripping infected quarters (HS), using quarter milkers (QM), culturing infected cows (CIC), culturing infected quarters (CIQ), and milking infected cows last (MICL). The dry period model included the fixed effects of abrupt dry off (ADO), seal teat ends (STE), and vaccinate during dry period (VDP). In milking procedure results, only WG and PRD significantly (P < 0.05) improved milk quality and udder health. Wearing gloves was associated with reduced average actual SCC (122,000 vs 374,000; SE = 70.8), and a lower % of cows with SC scores = 7-9 (1.2 vs 9.2; SE = 2.19). Pre-dipping was associated with reduced average actual SCC (134,000 vs 363,000; SE = 69.7), and a lower % of cows with SC scores = 7-9 (1.9 vs 8.5; SE = 2.16). Among mastitis control practices, only CIC was significantly (P < 0.05) associated with improved udder health. Herds that CIC had a greater % of cows with SC scores = 0-3, and lesser % of cows with SC scores = 5 and 6. In the dry period, there was a trend (P = 0.069) for VDP to reduce the % cows with SC scores = 7-9 (1.9 vs 8.8; SE = 2.8). These results suggest that BMP used with conventionally-managed dairy herds can effectively improve milk quality and udder health in OM dairy herds.

Key Words: Organic, Milk Quality, BMP

137 Increasing lighting program effects on production characteristics of modern broilers. K. Schwean-Lardner*[1], H. L. Classen[1], and B. I. Fancher[2], [1]*University of Saskatchewan*, *Saskatoon, Saskatchewan Canada*, [2]*Aviagen North America*, *Huntsville, AL*.

An experiment was conducted comparing growth parameters, meat yield characteristics and mobility indices of broilers (Ross × Ross 308) when raised under three lighting programs, initiated at 7 d of age (14L:10D; 23L:1D; increasing (INC) (7-14 d = 14L:10D, 15 -19d = 16L:8D, 20 - 24 d = 18L:6D, 25 - 29 d = 20L:4D, 30 - 34 d = 22L:2D, and 35 - 38 d = 23L:1D)). Three room replications were used per lighting program, and each room contained 6 pens for each sex of Ross x Ross 308 broilers (total number placed - 5022). Interactions between sex and lighting program were minor, so only overall lighting effects are reported. All numeric data is presented in order of 14L, 23L and INC, respectively unless otherwise stated. Bird weights at 31 (1.683c, 1.714b and 1.751a) and 38 (2.380b, 2.339b and 2.438a) d were highest with the use of an INC program. FCR was lowest for birds raised on 14L, and equal for INC and 23L (F:G 1.642b, 1.719a and 1.697a). Although not statistically different, mortality was highest when birds were raised on 23L (4.50%, 8.01% and 6.02%). Using an INC program resulted in an intermediate proportion of breast meat yield as a percentage of carcass weight (26.11c; 28.06a; 27.13b). In contrast, birds raised on 14L had heavier percent whole thighs (9.32a vs 8.87b for INC and 9.03b for 23L) and drums (7.01a vs 6.74b and 6.76b for 23L and INC respectively). Mobility (measured by gait scoring) was best when birds were raised under 14L, and intermediate when an INC program was used (0.75b, 1.13a and 0.90ab), indicating better welfare with regards to leg defects than birds raised under 23L. In conclusion, use of an INC program resulted in the most rapid growth and was intermediate in the level of mortality, breast muscle production, and leg weakness to 14L and 23L programs.

Key Words: Broiler, Photoperiod, Gait Score

138 Does broiler breeder flock age influence embryonic metabolism in different genetic strains? J. A. Hamidu*[1], G. M. Fasenko[1], E. E. O'Dea[1], J. J. R. Feddes[1], C. A. Ouellette[1], V. L. Christensen[2], and M. J. Wineland[2], [1]*University of Alberta*, *Edmonton, Alberta, Country*, [2]*North Carolina State University*, *Raleigh*.

The study examined the effect of genetic strain (Ross 308 (R); Cobb 500 (C)) and flock age on eggshell conductance (G), and embryonic metabolism. The G value was calculated on 30 hatching eggs from mature (M) (45 wk), old (O) (55 wk), and very-old (VO) (59 wk) flocks during 9 d from egg moisture loss and vapor pressure difference. Ten eggs per strain by flock age were also weighed and incubated for 21.5 d in individual metabolic chambers to measure embryonic O2 consumption and CO2 output. The data were then used to calculate the respiratory quotient (RQ = CO2/O2) and embryonic metabolic heat production during incubation. After hatching the chicks were euthanized, the yolk sacs removed, and the wet and dry wt obtained. Data were analyzed by SAS® GLM at P≤0.05. Genetic strain did not affect the G value but flock age had an effect; the O flock had a higher G (20.20±0.79 mg/day/mmHg) than the M flock (17.46±81), but neither of these differed from the VO flock (19.17±0.78) over the 9 d. However the R strain produced more average heat (88.48±1.78 mW) than the C (83.56±1.76 mW) over 21 d. Flock age did not affect embryonic heat production. Strain did not influence mean RQ but mean RQ was higher in M (0.82±0.009) versus the O (0.67±0.008) and VO (0.67±0.008) flocks. Chick wt did not differ between strains, but chicks from the VO flock were heavier (49.22±0.28g) than either the M (47.33±0.29g) or O (47.04±0.29) flocks. Wet carcass was significantly heavier in M (81.37±0.46) than O (79.95±0.46) flocks while dry carcass was heavier in M (16.18±0.251) than both O (15.82±0.25) and VO (15.43±0.24) flocks. Wet yolk sac was heavier in O (19.30±0.44) than VO (17.89±0.44) and M (18.20±0.42) flocks while dry yolk sac was heavier in O (10.96±0.27) than M (10.04±0.27) but not VO (10.24±0.26) flocks. The study showed that genetic selection of modern broiler strains has impacted embryonic heat production. The results also showed that as flock age increased the embryos increasingly used more fat substrates than carbohydrates.

Key Words: Genetic Strain, Flock Age, Embryonic Metabolism

139 Effects of *in ovo* injection of select salt solutions and metabolic compounds on chicken embryo livability and growth. B. M. McGruder*[1], E. D. Peebles[1], D. A. Braasch[1], M. A. Dekich[2], P. D. Gerard[1], and R. W. Keirs[1], [1]*Mississippi State University*, *Mississippi State*, [2]*AviTech, LLC*, *Salisbury, MD*.

Pilot trials were conducted to evaluate the effects of various physiological salts and metabolic compounds administered *in ovo* on the livability and growth of broiler embryos. Solutions of 200 µL were injected into the amnion of embryos at d16 of incubation using an AviTech Intellijject™ single egg injector. Based on their potential to augment nutrient metabolism and subsequent growth, the efficacies of potassium chloride (KCl) (110, 118, 125, 130 mM), sodium acetate (0.5, 1.0, 1.5, 2.0 mM), and monosodium phosphate (4.0, 4.5, 5.0, 5.5 mM) were evaluated in trial 1. Also, based on their potential to affect diverse metabolic pathways and stimulate growth, the efficacies of tripotassium citrate (1x, 2x, 4x, 8x), a carbohydrate/electrolyte nutrient solution (CEN) (1x, 2x, 4x, 8x), and caffeine (1x, 3x, 6x, 9x), in relative concentrations, were examined in trial 2. Physiological saline and non-injected treatments were used as standard controls in both trials. In both trials, the following were examined on d18 of incubation: embryo mortality; relative embryo weight and moisture content; relative dry embryo weight; and relative yolk sac weight and yolk moisture content. None of the injected solutions had a significant effect on embryo mortality. However, KCl at all molarities and physiological saline increased relative yolk sac weight in comparison to non-injected controls. All relative concentrations of the metabolic compounds decreased relative embryo BW, and the CEN injection at all 4 relative concentrations increased embryo moisture and decreased embryo dry matter content. In conclusion, injection of physiological saline and KCl into the amnion at d16 may provide a yolk sparing effect and may subsequently have a positive effect on post hatch chick growth. Furthermore, all the salt solutions tested have the potential for use in commercial egg injection, and might also be combined with the metabolic solutions examined to promote hatchability and post-hatch growth.

Key Words: Embryogenesis, *In Ovo* Injection, Physiological Compounds

140 Partial coefficients of nutrient partitioning of broiler breeders using different feeding strategies during the production phase. L. F. Romero*[1], M. J. Zuidhof[2], A. Naeima[1], F. E. Robinson[1], and R. A. Renema[1], [1]*University of Alberta*, *Edmonton, AB, Canada*, [2]*Alberta Agriculture and Food*, *Edmonton, AB, Canada*.

This study was conducted to identify a model to estimate partial coefficients of nutrient partitioning of broiler breeders using a set of biologically meaningful explanatory variables of ME intake and compare the coefficients among different feed allocation strategies. A total of 288 pullets (Ross 708) were reared in floor pens, individually caged at 16 wk and assigned to one of four feed allocation groups. Three groups had feed allocated on a group basis with divergent target BW reached at 20 wk: Standard (STD), HIGH (STD × 1.1), and LOW (STD × 0.9). The fourth group had feed allocated on an individual bird basis (IND) and followed the STD BW target. Models explained average daily ME intake using weekly data from 20 to 52 wk and regressions used generalized least squares. Maintenance estimates were based on Metabolic BW (MBW=$BW^{0.67}$). Model fit was assessed with the Bayesian Information Criterion (BIC). A total of 9394 valid observation sets were used. Besides MBW, Average Daily Gain (ADG) and Egg Mass (EM) (BIC=94187.9), improvements of fit allowed the inclusion of MBW × temperature (T), MBW × T^2, percentage of yolk, wk from first egg, wk before first egg, corrections due to negative ADGs, and hours of photoperiod (BIC=83958.3). The residuals showed a peak at the beginning of egg production in all groups. ME requirements increased by 3.26 kcal/wk (SE=0.22) before, and decreased by 4.16 kcal/wk (SE=0.04) after the first egg. From a model including MBW, ADG and EM, partial coefficients of the pooled data were 117.36 kcal ME/kg MBW (SE=0.73), 3.33 kcal ME/g ADG (SE=0.04) and 2.16 kcal ME/g EM (SE=0.03). Compared to STD, LOW hens showed higher MBW and lower ADG and EM coefficients, and HIGH hens showed higher ADG and EM coefficients (P<0.001). IND hens showed lower MBW and higher ADG and EM coefficients than STD hens (P<0.001) although there were no differences in the residuals between these two groups (P=0.127).

Key Words: Broiler Breeders, ME Partitioning, Residual Feed Intake

141 Broiler breeder strain and egg size affect egg characteristics, hatchability, and broiler performance in old flocks. A. M. Franco*, G. M. Fasenko, and E. E. O'Dea, *University of Alberta*, *Edmonton, Alberta, Canada*.

Broiler breeder flock age is an important factor in determining egg and chick quality. This trial analyzed the effects of strain and egg size on egg characteristics, hatchability, and broiler performance using eggs from 59 wk old flocks. Eggs were collected from two strains (Ross308 (R), Cobb500 (C); n=1380/strain) and three egg sizes (small (S), medium (M), large (L); n=920/size). Specific gravity, albumen, shell and yolk weights were measured in 30 eggs/strain/size, the remaining eggs were incubated. Saleable chicks were weighed, placed in floor pens (n= 2 pens of 119 chicks/strain/size) and grown out for 42 days. Daily mortality, 3 and 6 wk feed consumption and BW were recorded. Data were analyzed using SAS proc Mixed (P≤0.05). C eggs were heavier (71.3±0.09g) than R (68.3±0.09g), had higher specific gravity (1.075±0.0005) than R (1.071±0.0005), and higher % dry shell (C=8.6±0.07%; R=8.3±0.07%). S eggs had higher % dry shell (8.6±0.08%) than L (8.3±0.08%). Strain and size affected % egg weight loss at transfer: R was higher (13.4±0.08%) than C (11.8±0.08%) and S (13.3±0.1%) higher than M (12.4±0.1%) and L (12.2±0.1%). Infertility was greater in R (20.7±0.86%) than in C (5.5±0.86%). Early embryo mortality was greater for R (6.4±0.64%) than for C (4±0.64%), but late embryo mortality was the opposite (C=4.5±0.56%; R=2.9±0.56%). S eggs had lower late embryo mortality (2.4±0.69%) than M (3.5±0.69%) and L (5.2±0.69%) and higher hatchability of fertile eggs (S=87.3±1.22%; M=86.3±1.22%; L=84±1.22%). S eggs hatched sooner (496.7±1.19h) than M (501.4±1.19h) or L eggs (503.1±1.19h). C eggs hatched heavier chicks (48.9g±0.07g) than R (44.3±0.07g), and L eggs hatched heavier chicks (51.6g±0.08g) than M (48±0.08g) and S (44.6g±0.08g). The results indicate that strain and egg size affected egg quality and hatchability in old flocks; future research should evaluate specific incubation conditions based on strain and size to improve hatchability.

Key Words: Broiler Breeder Strain, Egg Size, hatchability

142 Effect of early and late incubation temperature profiles and hatching basket ventilation on broiler embryonic development. K. E. Brannan*, N. Leksrisompong, P. W. Plumstead, J. H. Small, E. O. Oviedo-Rondon, and J. T. Brake, *North Carolina State University*, *Raleigh*.

An experiment was conducted to examine the effects of early and late incubation temperature profiles and hatching basket ventilation during the last 4 d of incubation on embryonic development. Eggs from a 52-wk-old Ross 344 × 708 broiler breeder flock were divided equally between two incubators to create an Early Hot (EH) treatment with an average air temperature of 38.1°C and an Early Cool (EC) treatment with an average air temperature of 36.9°C during E0 to E3 of incubation. From E4 to E18, both machines were adjusted to maintain an egg shell temperature of 37.5°C. On E15, 40 eggs from each early temperature treatment were sampled. Embryo weight and length were significantly larger in the EH treatment while yolk and albumen weights were significantly smaller. At transfer on E18, eggs were randomized by tray within each early temperature treatment and placed into plastic hatching baskets with 170 eggs in each basket. The plastic hatching baskets were divided into two ventilation treatments of top taped (TT) and control (CN) and then equally divided between two hatchers representing two late temperature treatments. One machine was designated as Late Hot (LH) and maintained at an air temperature of 38.2°C, while the other machine was designated as Late Cool (LC) and maintained at an air temperature of 36.1°C. At hatching, chick BW and relative weights of the yolk, heart, proventriculus, and gizzard were determined. The EH treatment chicks were longer and exhibited larger gizzard and proventriculus weights despite having a smaller BW and yolk sac. The LH treatment produced a smaller BW but no other differences. Basket ventilation also did not product any differences. Although there were no two-way early by late incubation temperature interactions the EC treatment consistently produced smaller proventriculus weights across the three-way interactions.

Key Words: Ventilation, Incubation Temperature Profile, Egg Temperature

143 Effect of early and late incubation temperature profiles on broiler long bone development. J. H. Small*, K. E. Brannan, N. Leksrisompong, P. W. Plumstead, J. Brake, and E. O. Oviedo-Rondón, *North Carolina State University*, *Raleigh*.

Incubator conditions during the plateau stage of incubation can affect avian long bone development. This experiment was conducted to evaluate the effects of early and late incubation temperature profiles on broiler long bone development at hatching. A 2 × 2 factorial design of treatments was applied during early, E0-E3, and late, E18-E21, incubation. Eggs from 52-wk-old Ross 344 x 708 breeders were divided equally among two incubators to create Early Hot (EH) and Early Cool (EC) air temperatures of 36.9 and 38.1°C, respectively. Both machines were adjusted to maintain eggshell temperatures of 37.5°C from E4 to E18. At transfer on E18, eggs were randomized by tray within each early temperature treatment and placed into plastic hatching baskets in both machines. One machine was then designated as Late Hot (LH) with an air temperature of 38.2°C, and the other was designated as Late Cool (LC) to maintain an air temperature of 36.1°C. At hatching, 15 chicks from each treatment were randomly selected. BW and yolk sac weights were recorded, and legs were removed. Weight and length of tibia, femur and shanks were determined. Relative percentages of bones and fluctuating asymmetry for each limb section were calculated. Hatchlings from the EC treatments had the heaviest BW ($P < 0.001$) and reduced yolk absorption ($P < 0.001$), but yolk-free BW was not affected by the treatments. The EC profiles increased ($P \leq 0.05$) shank weights. The highest relative asymmetry of femur ($P < 0.01$) and tibia length ($P < 0.05$) was observed with the ECLH profile. In conclusion, the EC incubation profiles may affect long bone development and increase relative asymmetry of legs in day-old chickens especially when they are placed in hatchers with hot temperature profiles. These results may have implications on broiler leg health during grow-out.

Key Words: Incubation Temperature Profile, Bone Development, Broiler Leg Health

144 Feeding broiler breeder hens twice a day after photostimulation improves reproductive performance. J. M. Spradley*, M. E. Freeman, J. L. Wilson, and A. J. Davis, *University of Georgia*, *Athens*.

After photostimulation, the reproductive performance of broiler breeder hens is sensitive to extended periods of fasting. In a past experiment, extending a skip-a-day feeding program past photostimulation until five percent egg production decreased total egg production by more than 19 eggs per broiler breeder hen through 65 weeks of age, as compared to commencing a once a day feeding program after photostimulation. In the current research the effects on reproductive performance of shortening the fasting period even further by implementing a twice a day versus a once a day feeding program after photostimulation was investigated. Pullets were reared using a skip a day feeding program from 2-21 weeks of age. All pullets were weighed at 20 weeks of age and then distributed into 30 laying pens (35 hens and 4 roosters per pen) such that each pen had a similar body weight distribution. At 21 weeks of age 15 of the laying pens were placed on a once a day feeding schedule while the other 15 pens were placed on a twice a day feeding schedule. The total amount of feed provided per day to all the laying pens was the same; however, the birds fed once a day received all of their feed at 6:30AM, while the birds fed twice a day received 60% of their total feed allotment at 6:30 AM and the other 40% at 3:00PM. Even though both treatment groups began egg production at the end of week 23, the birds receiving feed twice a day have laid significantly more eggs through 45 weeks than those fed once a day. Since 26 weeks of age, eggs produced by birds fed twice a day have been significantly and consistently heavier by about 1g than the eggs produced by the birds fed once a day. Feeding hens twice a day has also improved their body weight uniformity compared to the hens fed once a day. These results further demonstrate that to achieve optimum reproductive performance in broiler breeder hens it is necessary to limit fasting durations after they have been photostimulated for reproduction.

Key Words: Broiler Breeder Hen, Twice a Day Feeding, Egg Production

145 Relationships between broiler breeder body weight, breast meat development, and reproductive tract development. N. Leksrisompong*, E. O. Oviedo-Rondon, and J. T. Brake, *North Carolina State University*, *Raleigh*.

A study was conducted to investigate the relationships between broiler breeder female BW, breast meat development, and reproductive tract development as influenced by two feed allocation programs during the rearing period followed by two feed increase rates from photostimulation to peak egg production. Females were reared on litter with either of two feeding programs (Low or High) from hatching to 23 wk of age and then moved to individual cages and subjected to either Slow or Fast feed increments from photostimulation to peak egg production in a 2 × 2 factorial design. BW was determined on individual hens at 24 wk, fifth egg, and 44 wk of age. Breast muscle weight was estimated by real time ultrasound at 24 wk and fifth egg while all birds were killed and deboned to determine actual breast meat at 44 wk of age. Weights of the ovary and oviduct segments were also taken at 44 wk. Hens were inseminated artificially at 39 wk and eggs collected for 14 d. Pullets from the High feeding program weighed more at 24 wk but only the High-Fast combination hens were heavier than the other hens at 44 wk. Larger hens possessed greater breast meat at 24 wk and 44 wk. BW at fifth egg was positively correlated with uterus and magnum, but not ovary and other oviduct segment weights at 44 wk. Hens from the Low and Slow feeding programs had the heaviest magnums while hens from the High and Slow programs had the smallest magnums. In a similar manner, breast meat weight at 44 wk was correlated only with magnum weight. These data suggest that the oviduct segments and ovary were not developing in a synchronous manner relative to BW and breast meat development. Feeding programs consistently caused variations in magnum weight but not in any other part of the oviduct. The High feeding program during rearing produced hens that exhibited poorer fertility probably due to their greater biological age at the time of insemination.

Key Words: Broiler Breeders, Oviduct, Ovary

146 Effect of female broiler breeder BW profile and rate of lay on broiler chick traits, growth performance and meat quality. A. Naeima*[1], L. F. Romero[1], M. J. Zuidhof[2], R. A. Renema[1], and F. E. Robinson[1], [1]*University of Alberta*, *Edmonton, AB., Canada*, [2]*Alberta Agriculture and Food*, *Edmonton, AB., Canada*.

The impact of divergent female BW profiles from 16 wk of age on broiler offspring chick quality, yield, and meat quality was assessed

in Ross 708 broiler breeders. At hatch, 216 pullets were assigned to a BW profile group and reared in floor pens on a common BW target. Pullets were individually caged at 16 wk. Feed allocation was altered for each group to achieve the following BW profile targets by 20 wk of age: Standard (Std), High (Std × 1.1), and Low (Std × 0.9). In the first study (32 wk of age), eggs from 1 wk were incubated and the 988 resultant broilers assessed for chick quality traits and grown to either a 39 or 49 d processing age. Eggs from this period (30-31 wk of age) from Low hens were smaller and had a lower proportion of yolk than eggs from Std or High hens (P<0.0001). Chick length and weight were also lower in Low chicks (P<0.0001), but differences disappeared by 11 d of age. Maternal BW profile did not affect broiler feed efficiency or meat quality traits (pH, color, drip loss, cook loss and tenderness). At 45 wk of age, broiler growth efficiency and yield was assessed in a comparison of the offspring of the 11 best (high: HE) and 11 worst egg producers (low eggs: LE) from each BW profile. The progeny were brooded on litter-floored cages, separated by dam and sex (2 × 3 × 2 factorial design). At this maternal age, eggs from Std hens had the lowest transfer and hatch weights (P<0.0001), although differences did not persist. The best egg layers (HE) produced 40.2 g chicks compared to 44.3 g chicks in the LE treatment, reflecting their smaller egg size. The HE chicks also had a reduced length at hatch (P<0.0028). Their BW remained 5% lower, but with similar % breast yield. Breast muscle from HE broilers was brighter (L*) than breast from the LE broilers (P<0.0002). While this suggests potential differences in muscle quality, drip loss, cooking loss and tenderness were similar.

Key Words: Broiler Breeder, Growth Rate, Meat Quality

147 The relationship between female feather cover, mating frequency and male–to–female aggression in Broiler Breeders. D. E. Holm*[1], R. A. Renema[1], F. E. Robinson[1], and M. J. Zuidhof[2], [1]*University of Alberta*, *Edmonton, Alberta, Canada*, [2]*Alberta Agriculture and Food*, *Edmonton, Alberta, Canada*.

A 3 × 4 factorial design study was performed to examine the relationship of feather cover in female broiler breeders with male BW distribution, aggression, and sexual behavior. Ross 308 broiler breeders (264) were housed in 8 rooms (17.13m^2 with 60% slats) of 30 hens and 3 roosters. Hen feather score (FS) was based on a 5–point scale with 6 focal hens per room consisting of 2 hens/FS1 (poor), FS3 (moderate) and FS5 (excellent). Male tmt (2 pens/tmt) were based on BW distribution: High Uniform (HU) (BW range<500g), Uniform (U) (BW range= 600g), Skew High (SH) (2 males 700g>1 male), and Skew Low (SL) (2 males 700g<1 male). Rooms were videotaped using ceiling–mounted cameras for 3–hr/d for 3 consecutive days from 6 to 9 pm. Focal scan sampling of all 72 hr of tape documented incidence of specific aggressive and mating behaviors and instantaneous location scans done every 5 min. Birds were dissected to characterize reproductive morphology. Proc MIXED was used to assess differences in mating and aggressive behaviors, and reproductive morphology. Hens with poor feather cover (FS1) had a lower BW (3.65kg) than hens with moderate (3.97kg) (FS3) or excellent (4.16kg) (FS5) feather cover. The better-feathered FS3 and FS5 hens spent more time on the slatted area compared to the FS1 hens. This could indicate a relationship between feather score and mating frequency. The HU and SH (mean of 5.81 events) male BW treatments demonstrated more male to female aggressive pecks and grabs compared to males of the U and SL (mean of 0.78 events) treatments. The U and SL treatments may have more behavioral stability because one male of higher BW being able to maintain a dominant role. No relationship between feather cover and reproductive morphology was found. Feather cover may be used as general but not definitive indicator of mating frequency while male BW distribution can be used as an indicator of potential male to female aggressive behaviors.

Key Words: Broiler Breeders, Feather Cover, Aggression

148 Novel isolation procedures for developing probiotic cultures against *Campylobacter* for poultry. V. F. Aguiar*[1], I. Reyes-Herrera[1], F. Solis de los Santos[1], M. L. Dirain[1], J. Metcalf[1], P. J. Blore[1], A. M. Donoghue[2], and D. J. Donoghue[1], [1]*University of Arkansas*, *Fayetteville*, [2]*PPPSRU, ARS, USDA*, *Fayetteville, AR*.

Campylobacter is a pathogenic bacterium that is a leading cause of food borne illness associated with the consumption of poultry products. *Campylobacter* is commonly present in the intestinal tract of poultry and one strategy to reduce enteric colonization is the use of probiotic cultures. These cultures consist of beneficial bacteria which may displace enteric pathogens. Although probiotic cultures have been successfully used to reduce enteric *Salmonella* colonization, their use has met with limited success against *Campylobacter*. In an effort to improve the efficacy of probiotic cultures, new isolates have been collected and identified by our laboratory. Cecal contents from approximately 300 healthy chickens were collected and diluted in Butterfield′s Phosphate Diluent and inoculated onto both Blood Agar Plates and Lactobacilli MRS broth and incubated at 37°C over night. Isolates were identified using Gram stain and the Biolog© system. Only isolates meeting the GRAS (Generally Recognized as Safe) status according to the Food and Drug Administration were considered for probiotic development. The 45 isolates meeting this criterion were co-incubated with *Campylobacter*, *in vitro*, to determine their ability to reduce *Campylobacter* growth. Of these 45 isolates, 11 isolates inhibited *Campylobacter* growth. We are currently in the process of evaluating the ability of these isolates to reduce gastrointestinal *Campylobacter* colonization in chickens.

Key Words: *Campylobacter*, Probiotic Culture, Poultry

149 Effects of chemical treatment of canola meal on nutrients ruminal degradation in Zel sheep using in situ methods. A Teimouri Yansari*[1] and H. MohammadZAdeh[1], [1]*University of Agriculture and Bioresource*, *Sari, Mazandaran, Iran*, [2]*University of Agriculture and Bioresource*, *Sari, Mazandaran, Iran*.

The experiment was conducted to determination the effect of chemical treatment on in situ degradation of dry matter, crude protein and neutral detergent fiber (NDF) of canola meal (CM). Canola meal was treated by spraying with acetic acid, formic acid, hydrochloric acid, sulfuric acid and formaldehyde at 0.0, 1.0, 2.5 and 5.0% (vol/wt). Ruminal degradability of CM was measured by the nylon bag technique using two fistulated Zel ewes (approximately 1 yr old, BW= 30±2 kg) fed alfalfa hay and barely grain in a ratio of about 75:25 (DM basis). Incubation time consisted of 1, 3, 6, 12, 24 36 and 48 h. This experiment was a completely randomized design with 5×3 factorial arrangement of treatment. Ruminal degradability of DM, CP and NDF were significantly influenced by chemical treatment, level, and the interaction of chemical treatment and level. The acids and formaldehyde significantly reduced the soluble, potential degradable fraction, and rate of degradation of DM and protein. Only acids significantly increased the soluble, potential degradable fraction, and rate of degradation of NDF. However, formaldehyde was not influenced by rumen degradability of NDF. In addition, as the concentration of acids increased, their influences were similarly increased. The results of this experiment showed that chemical treatment can improve the utilization of CM in ruminants by reducing and increasing of ruminal degradation of protein and NDF, respectively.

Key Words: Canola Meal, Ruminal Degradability, Nylon bag Technique

150 Effects of chemical treatments of rice straw on rumen fermentation, fibrolytic enzyme activities and populations of liquid- and solid-associated ruminal microbes in vitro. X. L. Chen, J. K. Wang, Y. M. Wu, and J. X. Liu*, *College of Animal Sciences, Ministry of Education Key Laboratory of Molecular Animal Nutrition, Zhejiang University*, *Hangzhou, China*.

The study was to investigate the effects of treatment of rice straw (RS) with NaOH (SH) and NH_4HCO_3 (AB) on fermentation, fibrolytic enzyme activities and populations of liquid- and solid-associated ruminal microbes in vitro. Fibrolytic specific activities were estimated by the amount of reducing sugars released from the solid-bound microbes. Total DNA was extracted from the liquid- and solid-associated ruminal microbes, respectively, and populations of rumen fungi, *Ruminococcus flavefaciens* (Rf) and *Fibrobacter succinogenes* (Fs) were determined by real-time quantitative PCR. Microbial protein mass increased with incubation time, and was higher for the treated straws than for the untreated ($P<0.05$). Both treated and untreated straws maintained a typical roughage type of fermentation with a high proportion of acetate. The SH treatment increased carboxymethyl cellulase and avicelase activities at all incubation times. Both SH and AB treatments significantly increased xylanase activity. Rumen fungi were significantly increased with incubation time in both liquid and solid phases for SH-RS, but not affected by AB treatment. Both solid- and liquid-associated Rf were higher in treated straws than in the untreated, with higher solid-associated Rf in SH-RS than in AB-RS at early incubation. Solid-associated Fs was lower and liquid-associated Fs was higher in SH-RS than in other two straws. Liquid-associated Fs was lower at early incubation in AB-RS. It is inferred that chemical treatments enhance the nutritive value of RS through improving rumen fermentation and fibrolytic enzyme activities, and has great influences on rumen microbial distribution and populations, but their fluctuating pattern with incubation time is slightly different between two treated straws.

Key Words: Rice Straw, Fermentation, Ruminal Microbes

151 Effects of feeding thermochemically-treated wheat straw and corn stover on lamb performance and digestibility. N. A. Pyatt[1], P. H. Doane[1], M. J. Cecava*[1], J. L. Dunn[1], J. R. Sewell[2], and L. L. Berger[2], [1]*ADM Animal Nutrition Research*, *Decatur, IN*, [2]*University of Illinois*, *Urbana*.

Fifty-two individually-fed lambs (39.37 ± 0.62 kg) were utilized in a 28-day 2 × 3 (+1) factorial design study to assess if thermochemically-treated wheat straw and corn stover can replace corn in ruminant diets. Wheat straw or corn stover were treated with 5% CaO and water in a double-shaft enclosed mixer (Readco® Continuous Processor) and subsequently pelleted with DDGS (75% residue:25% DDGS; DM basis) to form corn replacement pellets (CRP). The Control diet consisted of 45% cracked corn, 24% DDGS, 12% soyhulls, 10% grass hay, 6% supplement, and 3% cane molasses. The CRP was fed at 0%, 20%, 40%, or 60% of diet DM and replaced corn and DDGS. Final weight tended greatest for lambs fed Control, 40% CRP-straw, or 20% CRP-stover diets, and least for animals fed either 60% CRP treatment. Final BW decreased linearly with CRP inclusion but more so for stover than straw. Feeding 20% CRP-stover and 40% CRP-straw lambs maintained gain at about 90% of Control. Intake increased with increasing amounts of CRP-straw, but decreased with CRP-stover. Cumulative feed efficiency of 20% CRP-stover and 40% CRP-straw lambs was maintained at 81.5% and 88.9% of Control lambs. Gain and efficiency decreased linearly with CRP inclusion, but at a greater rate for CRP-stover. Fecal DM output increased and DM digestibility decreased linearly with CRP treatment, but at a greater rate and extent for CRP-stover. In general, CRP lambs had 9.7% greater DMI, 52.3% greater manure output, and 26.4% lesser DM digestibility. However, lambs fed 20 or 40% CRP-straw or 20% CRP-stover had similar ($P>0.31$) DM and OM digestibility versus Control. Lambs fed CRP tended to have greater intakes of protein, NDF, and ADF but similar digestibility of these nutrients versus Control. Phosphorus digestibility tended lower for CRP diets. Feeding treated straw or stover at ≤ 30% of diet DM to replace corn may be feasible in ruminant diets.

Key Words: Ruminants, Corn Replacement, Treated Crop Residues

152 Effects of feeding thermochemically-treated crop residues on lamb intake and performance. N. A. Pyatt[1], P. H. Doane[1], M. J. Cecava*[1], J. L. Dunn[1], J. R. Sewell[2], and L. L. Berger[2], [1]*ADM Animal Nutrition Research*, *Decatur, IN*, [2]*University of Illinois*, *Urbana*.

Two 30-day lamb growth experiments were conducted to assess thermochemically-treated crop residues in lamb diets. In both studies,

residues were mixed with 5% CaO and water in a double-shaft enclosed mixer (Readco® Continuous Processor) and subsequently pelleted with DDGS (75% residue:25% DDGS; DM basis) to form a corn replacement pellet (CRP). The Control diet contained (DM basis) 45% cracked corn, 24% DDGS, 12% soyhulls, 10% cottonseed hulls, 6% supplement, and 3% cane molasses. In Exp 1, 7 treatments were fed to lambs (n = 55; 25.6 ± 1.3 kg) in a 3 × 2 (+1) factorial. The CRP containing treated switchgrass, wheat straw or wheat chaff was fed 30% or 60% of diet DM and replaced corn and DDGS. In Exp 2, lambs (n = 56; 32.0 ± 1.4 kg) were fed Control diets in which CRP was fed at 30% of diet DM to replace corn and DDGS. Residues evaluated were wheat straw, wheat chaff, corn fiber, switchgrass, and 3:1 blends of corn fiber:wheat straw or corn fiber:wheat chaff. In Exp 1, feeding CRP increased feed intake with 30% CRP causing greater final weight and cumulative ADG (quadratic; P<0.05). Cumulative feed efficiency was 8.5% better (quadratic; P<0.05) for 30% CRP but 21.9% worse for 60% CRP versus Control. Relative efficacy of treated residues as potential corn replacements were wheat chaff > wheat straw > switchgrass. In Exp 2, interim and final weights were not different, but tended less for lambs fed CRP. Cumulative ADG for CRP diets was 15.9% less than Control but feeding CRP containing corn fiber and corn fiber:wheat chaff maintained growth at 90% of Control. Cumulative DMI was not different but cumulative feed efficiency was 20.3% worse for lambs fed CRP diets. Feed efficiency was similar for Control and CRP containing corn fiber:chaff or corn fiber. Thermochemically-treated corn fiber and crop residues fed at ≤ 30% of diet DM may be feasible alternatives to corn in ruminant diets.

Key Words: Ruminants, Corn Replacement, Treated Crop Residues

153 Digestibility of corn replacement pellets in growing lamb diets. J. R. Sewell*[1], L. L. Berger[1], M. J. Cecava[2], P. H. Doane[2], J. L. Dunn[2], and N. A. Pyatt[2], [1]*University of Illinois*, *Urbana*, [2]*ADM Animal Nutrition Research*, *Decatur, IN*.

The objective of this study was to evaluate nutrient digestibility of native (NAT) and thermochemically-treated crop residues (wheat straw, WS; corn stover, CS) relative to corn in ruminant diets. Treated residues were processed with 5% CaO and water in a double-shaft enclosed mixer (Readco® Continuous Processor) and subsequently pelleted with DDGS (75% residue: 25% DDGS; DM basis) to form corn replacement pellets (CRP). The Control diet consisted of 54% cracked corn, 22% DDGS, 22% corn silage, 2% CaCO3, and 0.04% urea on a DMB. Native and treated residues and DDGS were fed at 0, 30, or 60% of diet DM with the amount of DDGS in the diet equalized within feeding level for treated or NAT residue. All diets contained 0.4% urea and non-CRP diets contained 2% CaCO3 (DMB). Lambs (6 per treatment; 31.45 kg) housed in metabolism crates were fed diets at 1.8% of BW and used to determine total tract nutrient digestion. In Exp 1, diets were (DMB): 1) 54% corn, 2) 30% WS CRP, 3) 60% WS CRP, 4) 30% ground NAT WS: DDGS, and 5) 60% ground NAT WS. In Exp 2, CS replaced WS in CRP and NAT CS replaced NAT WS in diets. Data were analyzed using the MIXED procedure of SAS. In Exp 1, DM digestibility for diets 1-5 were: 87.7%, 81.3%, 69.6%, 74.1%, and 60.9%, respectively. Treating crop residue and feeding as part of a CRP increased digestion of DM, NDF, and ADF compared with feeding NAT residue (P<0.05). Feeding WS CRP versus a blend of NAT WS and DDGS at 30% and 60% of diet DM increased NDF digestibility by 48.3% and 103%, and ADF digestibility by 86.0% and 55.7%, respectively. In Exp 2, DM digestibility of diets 1-5 were: 92.2%, 83.3%, 70.7%, 76.4%, and 66.9%, respectively. Feeding treated CS as part of a CRP increased DM, NDF, and ADF digestibility versus feeding NAT CS (P<0.05). Feeding CS CRP versus a blend of NAT CS and DDGS at 30% and 60% of diet DM increased NDF digestibility by 46.5% and 44.2%, and ADF digestibility by 92.2% and 35.2%. Thermochemically treating crop residues improved nutrient digestibility by growing lambs.

Key Words: Corn Replacement, Digestibility, Lambs

154 Effects of diet adaptation on performance and health of steers grown on a high-concentrate, program-fed diet. B. P. Holland*, C. R. Krehbiel, D. L. Step, L. O. Burciaga-Robles, and J. J. Cranston, *Oklahoma State University*, *Stillwater*.

Five hundred thirty-six steers (initial BW = 284 kg) originating from auction markets were used to evaluate four methods of adaptation to a high-concentrate diet for a 60 d growing period. Steers were blocked by arrival date and BW and allocated by adaptation treatment into 24 pens. Treatment 1 included three diets with an increasing percentage of concentrate from 65% to 80% fed ad libitum during the first 21 d prior to feeding an 88% concentrate diet (TRAD). Steers in Treatment 2 were fed ad libitum the same 65% concentrate diet as in TRAD for the first 28 d, followed by adaptation to and feeding of the 88% concentrate diet (REC). Steers in Treatment 3 were fed similarly to TRAD; however, maximum feed intake was limited to 2.1, 2.3, and 2.5 times the arrival maintenance energy requirement for wk 1, 2, and 3, respectively (LMI). Steers in Treatment 4 were initially fed a restricted level of the 88% concentrate diet with daily increases in intake of 0.23 kg/d (PF). Steers in all treatments were fed the final diet at a level that targeted ADG at 1.13 kg/d. Fecal samples were obtained on d 11, 22, 43, and 60 from 6 steers/pen for pH measurement. BW, ADG, and ratio of daily ME intake:ADG (MEG) did not differ among treatments for the first 22 d (P=0.58; 0.41; 0.57, respectively). However, on d 43, REC steers had greater (P<0.01) BW and ADG than TRAD, LMI, and PF steers. Day 60 BW tended (P=0.056) to be greater for REC (352 kg) and TRAD (350 kg) steers than LMI (347) and PF (345 kg) steers. REC steers had the greatest (P<0.01) daily ME intake and lowest (P=0.03) MEG over the growing period. Fecal pH was not affected by treatment, but decreased (P<0.01) from d 11 (6.73) and 22 (6.72) to d 43 (6.59) and 60 (6.61). Bovine respiratory disease morbidity was greater (P=0.02) for TRAD (45.9%) and PF (43.6%) than REC (34.0%) and LMI (29.6%). Feeding a 65% concentrate receiving diet for 28 d after arrival improved growth efficiency and decreased morbidity of high-risk steers.

Key Words: Adaptation, Limited Maximum Intake, Program Feeding

155 Effects of roughage level and Fibrozyme™ supplementation on site and extent of digestion by finishing beef steers. J. J. Cranston and C. R. Krehbiel*, *Oklahoma State University*, *Stillwater*.

Eight ruminally and duodenally cannulated crossbred beef steers (initial BW = 620.4 ± 57.2 kg) were randomly allotted to 1 of 4 treatments in a replicated 4 x 4 Latin square design with a 2 × 2 factorial arrangement of treatments. Dietary treatments were dry-rolled corn-based, and included (DM basis): 1) no enzyme and 9% alfalfa hay; 2) no enzyme and 4.5% alfalfa hay; 3) Fibrozyme (10 g•steer^{-1}•d^{-1}; Alltech Inc., Nicholasville, KY) and 9% alfalfa hay; or 4) Fibrozyme (10 g•steer^{-1}•d^{-1}) and 4.5% alfalfa hay. Roughage level had an effect (P = 0.04)

on DMI. Averaged across enzyme supplementation levels, steers fed diets containing 9.0% alfalfa hay consumed more DM than steers fed diets containing 4.5% alfalfa hay. With the effect on DMI, roughage level also influenced intake of OM, ADF, NDF, starch, and nitrogen ($P \leq 0.10$). Duodenal flow of any measured nutrients was not affected ($P \geq 0.12$) by treatment. With the increased intake, roughage level also affected ($P \leq 0.06$) fecal excretion of OM, ADF, and NDF. However, fecal excretion of starch and nitrogen were not affected ($P \geq 0.15$) by roughage level. Ruminal digestibility, postruminal digestibility, and total tract digestibility of OM, N, ADF, NDF, and starch were not affected ($P \geq 0.11$) by treatment. Similarly, ruminal microbial efficiency was not affected ($P \geq 0.44$) by treatment. Increasing roughage level decreased ($P = 0.01$) particulate passage rate and increased ($P = 0.02$) the outflow of ruminal liquid. Increasing roughage level in the diet also increased ($P = 0.04$) the amount of time steers spent ruminating. The greater dietary roughage level decreased ($P = 0.02$) ruminal ammonia concentrations. An enzyme supplementation × roughage level interaction was detected ($P = 0.02$) for ruminal pH. Neither total ruminal VFA concentrations, nor molar proportions of acetate and propionate were affected by treatment ($P \geq 0.12$). While small changes in roughage level may influence intake and passage kinetics, it appears that nutrient digestibility remains fairly constant in dry-rolled corn-based finishing diets.

Key Words: Beef Cattle, Roughage Level, Fibrolytic Enzyme

156 The effect of delaying initial implant on finishing performance and carcass characteristics. W. A. Griffin*, D. C. Adams, and R. N. Funston, *University of Nebraska West Central Research and Extension Center*, *North Platte*.

Two separate two yr experiments were conducted to determine the effect of delaying initial feedlot implant on performance and carcass characteristics. Steers were preconditioned prior to feedlot entry. At receiving, steers were assigned to one of two treatments: 1) implant at feedlot entry (Norm) or 2) implant 30 d after feedlot entry (Delay). In exp. 1, steers (n = 200) were not implanted until feedlot entry; however, in exp. 2 steers (n = 209) were implanted at branding with Synovex C (Fort Dodge Animal Health, Overland Park, KS). Initial feedlot implant was Synovex S (Fort Dodge Animal Health, Overland Park, KS). At reimplant steers were given Synovex-Choice (Fort Dodge Animal Health, Overland Park, KS). Steers were reimplanted an average of 83 and 115 d after initial implant for Delay and Norm, respectively in exp. 1, and an average of 89 and 119 d after initial implant for Delay and Norm, respectively in exp. 2. In exp.1, initial BW, reimplant BW, and final live BW were not different (P = 0.16); however, BW at initial implant for Delay was 10 kg heavier for Norm (P < 0.01). In exp. 1 overall ADG was not different (P = 0.68); however, Norm had higher ADG for the first 30 d of the finishing period (P = 0.02). In exp. 2, BW measures were not different for Norm and Delay (P = 0.89). In both experiments, HCW, 12th rib fat thickness, LM area, and yield grade were not different (P = 0.28). In exp. 1, there was a significant yr*treatment effect for marbling score (P = 0.05) and percent of steers grading choice or higher (P = 0.05) with Delay grading 22.0% units more choice than Norm in yr 1 and Norm grading 14.5% units more choice than Delay in yr 2; however, in exp. 2, marbling score and percent choice were not different (P = 0.28). In these studies, delaying initial feedlot implant had no affect on animal performance. However, because of the yr*treatment interaction in exp. 1, delaying implant may affect quality grade.

Key Words: Feedlot, Implant, Performance

157 Effect of Dakota Bran inclusion on DMI, gain, efficiency, and carcass characteristics of finishing steers. D. M. Larson*[1], M. L. Bauer[1], G. P. Lardy[1], K. K. Karges[2], and M. L. Gibson[2], [1]*North Dakota State University*, *Fargo*, [2]*Dakota Gold Research Association*, *Sioux Falls, SD*.

A study was conducted to evaluate the effect of Dakota Bran (DB) inclusion on DMI, ADG, G:F, and carcass characteristics of finishing steers. Fifty-eight beef steers (454 ± 10 kg initial BW) were assigned randomly within weight strata to one of five dietary treatments. The diet DM consisted of 84% dry-rolled corn, 8% mixed hay, 5% liquid supplement, and 3% dry supplement providing 27.5 mg/kg monensin. Treatments consisted of DB replacing 0 (n = 8), 40 (n = 10), 50 (n = 8), 60 (n = 9), or 70% (n = 9) of dry-rolled corn DM. Steers were fed individually once daily using a Calan Broadbent feeding system. Body weight was measured every 28 d, individual feed offered recorded daily, and individual feed refusal recorded weekly. Steers were implanted with Synovex Choice on d 0 and were fed for 57, 77, or 105 d. Data were analyzed with the MIXED model of SAS with 0 vs. 40% DB, and linear and quadratic within DB level contrasts ($P \leq 0.05$). There were no differences ($P \geq 0.17$) between 0 and 40% DB treatments. Final BW (600 ± 7 kg; $P = 0.34$) and ADG (1.81 kg/d; $P = 0.40$) were not affected by DB level. The DMI increased ($P = 0.05$; quadratic) to 60% DB (11.25 ± 0.40 kg) and decreased at 70% (10.07 ± 0.40 kg) while G:F decreased ($P = 0.02$) linearly with increasing DB (192 to 170 ± 8 g/kg). Calculated apparent NEg decreased ($P = 0.02$) linearly with increasing dietary DB. Level of DB did not affect ($P \geq 0.18$) 12th rib fat (1.03 ± 0.17 cm), LM area (87.3 ± 2.9 cm2), KPH (2.11 ± 0.14%), or yield grade (2.71 ± 0.23) but marbling responded quadratically ($P = 0.05$) and was lowest at 50% and greatest at 70% (420 vs. 493 ± 25; 400 = small^0). It appears that replacing more than 60% of corn with DB negatively influences DMI while G:F is negatively impacted by increasing DB inclusion above 40%. However, further study with an increased number of observations is needed to fully quantify the effect of high levels of DB inclusion on finishing steer performance.

Key Words: Steers, Dakota Bran, Finishing

158 Effect of corn endosperm type and processing method on site and extent of nutrient digestion and ruminal metabolism in Holstein steers fed a high-grain diet. C. A. McPeake* and S. R. Rust, *Michigan State University*, *East Lansing*.

This experiment was conducted to evaluate the interaction between corn grain endosperm type and processing method on site of nutrient digestion and ruminal metabolism in steers consuming a high-grain diet. Ten ruminally, duodenally, and ileally cannulated Holstein steers (initial BW = 200 ± 21 kg) were used in a replicated 4 × 4 Latin square design experiment with a 2 × 2 factorial arrangement of treatments. Treatments were grain endosperm type (floury and flinty) and processing method (high moisture and dry-rolled). Interaction of treatments had no effect on any measure of digestibility or ruminal metabolism. Starch intake tended to be greater for diets containing dry-rolled corn, resulting in lower apparent ruminal degradability (P = 0.02) and greater starch passage (P = 0.01) to the duodenum. When expressed as a percentage of duodenal flow, 21% less starch was digested in the small intestine of steers consuming diets containing dry-rolled corn. Likewise, an 8% decline in apparent total-tract starch digestibility was witnessed when feeding dry-rolled corn. Ruminal passage rate of liquid was significantly higher (P = 0.03) for floury

endosperm treatments, while diets containing dry-rolled corn tended to have higher ruminal passage rates of starch. Total molar proportion of volatile fatty acid tended to be greater for diets including grain comprised of floury endosperm. While ruminal pH was unaffected by treatments, diets consisting of flinty endosperm resulted in greater ruminal ammonia levels ($P < 0.05$). Dry-rolled corn treatments tended to result in higher molar concentrations of lactate. Relative to nitrogen digestibility, diets containing high moisture corn resulted in greater amounts of microbial nitrogen flow to the duodenum, greater apparent post-ruminal nitrogen digestibility, and greater microbial efficiency ($P < 0.05$). Preservation method of corn grain appears to have a more profound impact on site and extent of nutrient digestibility than corn grain endosperm type.

Key Words: Corn Hybrid, Digestibility, Processing

159 The effects of feeding ground flaxseed on morbidity, mortality, and performance in receiving heifers and subsequent feedlot performance. M. J. Quinn*, E. S. Moore, B. E. Depenbusch, M. L. May, J. J. Higgins, and J. S. Drouillard, *Kansas State University*, *Manhattan*.

Two trials were conducted at the Kansas State University Beef Cattle Research Center to determine the effects of feeding ground flaxseed during the receiving period on growth, health, and subsequent feedlot performance of finishing heifers. Crossbred heifers (trial 1 n=363, initial BW 214±1 kg; trial 2 n=377, initial BW 222±1 kg) were purchased from salebarns in Edmonton, KY during January and March of 2006. Heifers were fed receiving rations based on steam-flaked corn with 0 (Control), 2, 4, or 6% ground flaxseed (DM basis) for 56 d. Following the receiving period, cattle were fed steam-flaked corn based diets until slaughter for 150 d and 147 d, respectively. Heifers were implanted 91 and 109 d prior to slaughter, respectively. In trial 1, DMI during the receiving period tended to increase linearly with increasing flaxseed in the diet ($P<0.10$). ADG was 1.46, 1.56, 1.58, and 1.61 kg/d for heifers fed 0, 2, 4, and 6% flax, respectively (linear, $P<0.03$). Final BW after the finishing period was significantly increased with increasing inclusion of flax in the receiving diets (linear $P<0.05$). In trial 2, growth performance, morbidity, or mortality during the receiving period were not different between treatments ($P>0.05$). During the finishing period DMI were 8.4, 8.4, 8.0, and 8.1 kg/d for 0, 2, 4, and 6% flax, respectively (linear, $P<0.05$). In trial 2, LM areas were greatest for cattle fed 2% flax at receiving (quadratic, $P<0.05$). In general, feeding flaxseed during the receiving period may improve growth performance and carcass weights through finishing. However, there is some variation that exists, and cattle fed flax may not always respond similarly.

Key Words: Flax, Receiving, Heifers

160 Effect of feeding das-59122-7 corn grain and non-transgenic corn grain to finishing feedlot steers. T. J. Huls*[1], G. E. Erickson[1], T. J. Klopfenstein[1], M. K. Luebbe[1], K. J. Vander Pol[1], D. W. Rice[2], B. L. Smith[2], M. A. Hinds[2], F. N. Owens[2], and M. K. Liebergesell[2], [1]*University of Nebraska*, *Lincoln*, [2]*Pioneer Hi-Bred Internation, Inc.*, *Johnston, IA*.

An experiment was designed to evaluate the performance of steers fed grain produced from a non-segregating transgenic maize line containing event DAS-59122-7 (59122). 59122 expresses the Cry34Ab1 and Cry35Ab1 proteins from *Bacillus thuringiensis* strain PS149B1. These proteins control corn rootworms. 59122 also contains the phosphinothricin acetyltransferase (*pat*) gene from *Streptomyces viridochromogenes* for herbicide tolerance. Sixty steers (initial BW = 396 ± 15 kg), individually fed using Calan gates, consumed finishing diets containing either transgenic corn (59122), or a non-transgenic, near isoline hybrid (Control), or a conventional non-transgenic corn hybrid (Pioneer hybrid 35P12) for 109 d to determine nutritional equivalency. Dry rolled corn comprised 82% of diet DM along with 8.5% alfalfa hay, 5% molasses, and 4.5% supplement containing monensin and tylosin. Steer performance and carcass traits were statistically compared between steers consuming diets produced with 59122 corn and steers consuming diets produced with Control corns. False discovery rate was used to control for multiplicity. Steers fed diets produced with the conventional corn were used as an additional comparator creating tolerance intervals to evaluate the biological significance of any statistical differences. Dry matter intake, ADG, and G:F for steers fed diets containing the 59122 corn were not significantly different from steers fed Control corn, and fell within the tolerance intervals. Similarly, carcass characteristics were not different between Control and 59122. Feeding 59122 did not impact steer performance or carcass quality.

Table 1. Performance and carcass characteristics of steers fed different corn hybrids.

Item	CONTROL	59122	SEM	P-value
Final BW, kg [1]	553	562	7	0.357
DMI, kg/d	9.51	10.11	0.25	0.083
ADG, kg	1.45	1.53	0.06	0.377
G:F	0.153	0.151	0.006	0.799
Marbling score [2]	463	475	19	0.651
Fat depth, cm	1.04	0.95	0.06	0.294

[1] Final BW calculated from HCW/0.63. [2] 400 = Slight°, 450 = Slight^{50}, 500 = Small°

Key Words: Beef Cattle, Transgenic, Maize

Ruminant Nutrition: Ruminal Fermentation - Dairy

161 Effects of *Saccharomyces cerevisiae* on ruminal pH and microbial fermentation in lactating dairy cows. M. Thrune[1], A. Bach[2], M. Ruiz-Moreno[1], M. D. Stern*[1], and J. G. Linn[1], [1]*University of Minnesota*, *St. Paul*, [2]*IRTA-Unitat de Remugants*, *Spain*.

An experiment was conducted with eight ruminal fistulated cows using a cross over design with 2 periods to determine the effects of yeast supplementation on rumen fermentation. Holstein dairy cows in late lactation were either supplemented with 0.5g/head/day of *Saccharomyces cerevisiae*, an active dry yeast (CNCM-1077, Levucell SC20 (r)SC, Lallemand Animal Nutrition) or not supplemented (control). A basal diet consisting of 60% forage and 40% concentrate (DM basis), was fed once daily to both groups of cows throughout the entire experiment. Ruminal pH was measured continuously every 22 min using a pH probe that was placed in the ventral rumen sac for 6 d. Volatile fatty acid and ammonia N concentrations in the rumen were

measured on day 5 or 6 of the 12-d period for each cow and DMI was monitored throughout the experiment. Data were analyzed using a mixed-effects model with repeated measures. There was no difference in DMI between treatments. Mean ruminal pH was greater ($P < 0.05$) when yeast was supplemented (6.53±0.07) compared with the control (6.32±0.07). Average maximum and minimum ruminal pH were also greater ($P < 0.05$) when yeast was supplemented (7.01±0.09 and 5.97±0.08, respectively) compared with the control (6.80±0.09 and 5.69±0.09; respectively). Time spent under the subacute acidosis threshold, pH less than 5.6, was lower ($P < 0.05$) with yeast supplementation compared with the control cows. No difference was observed for ruminal ammonia N concentrations (mean = 14.0 mg/dL) between treatments. Total VFA concentration (m*M*) in the rumen was lower ($P < 0.05$) in the yeast supplemented cows (107.8) compared with the control cows (122.8), which can be related to the greater pH observed with yeast supplementation. Supplementing dairy cows with active dry yeast in the current experiment increased the mean, minimum and maximum ruminal pH; decreased time spent in subactute acidosis; and decreased total VFA concentration in the rumen compared with control cows.

Key Words: Rumen, *Saccharomyces cerevisiae*, Fermentation

162 Impacts of a *Yucca schidigera* extract on rumen fermentation and *in vitro* gas production and NDF digestion. M. D. Singer*[1], P. H. Robinson[1], A. Z. M Salem[2], and E. J. DePeters[1], [1]*University of California*, *Davis*, [2]*University of Alexandria*, *Alexandria, Egypt*.

Yucca schidigera(YS) is native to the arid Sonoran deserts of the Southwest USA and Mexico, and its extracts have been used to modify rumen microbial fermentation. Our objective was to determine effects of feeding increasing doses of YS extract (9.5% Sarsaponin) to dairy cows on rumen fermentation, as well as 24 h *in vitro* gas production and 27 h *in vitro* NDF digestion, of 11 feedstuffs. The principle was to assess the ability of YS to modify rumen fermentation and the subsequent impact of the adapted rumen fluid on feedstuff fermentation *in vitro*. Ruminally cannulated lactating Holstein cows (4; 810 average kg BW) were used in a 4*4 Latin Square design experiment with 14 d periods. Cows were housed in pens equipped with Calan gates with *ad libitum* access to water. The TMR was fed twice daily and contained 36% alfalfa hay (ALF), 9.6% whole cottonseed (WCS), 2% soybean meal (SBM), 12% almond hulls (AH), 1.8% mineral mix, .9% Energy II, .4% salt, and 64% of a corn grain based concentrate (as fed basis). The study occurred in June/August 2006, when daytime high temperatures averaged 35C. YS was added to the TMR to provide approximately 0, 5, 10, 15 g of sarsaponin/cow/day. Rumen fluid from each cow in each period was utilized in an *in vitro* gas run to measure gas production and digestion of NDF for corn silage, ALF(high and low NDF level), beet pulp, corn grain, distillers grains, SBM, AH, barley grain, wheat silage and WCS. Rumen pH, concentrations of total VFA (and their molar proportions), and ammonia N, were not impacted (P>0.05) by level of sarsaponin. In spite of the lack of differences in parameters of rumen fermentation due to increased levels of sarsaponin, gas produced at both 4 and 24 h of *in vitro* fermentation increased linearly (6.3 and 5.6% mean increase with 15 g/d of sarsaponin for 4 and 24 h; both P<0.01), and there were no treatment by feed interactions (i.e., both P>0.05). *In vitro* digestion of NDF was not impacted (P>0.05) by sarsaponin level. Sarsaponin addition at high levels, compared to previous studies, had a modest positive impact on gas production of 11 common feedstuffs.

Key Words: *Yucca Schidigera*, *In Vitro* Gas Production

163 Yeast culture supplementation prevented milk fat depression from a fermentable carbohydrate challenge. R. A. Longuski*, Y. Ying, and M. S. Allen, *Michigan State University*, *East Lansing*.

Effects of yeast culture (YC) on responses to a fermentable carbohydrate challenge were evaluated using eight ruminally cannulated mid-lactation multiparous Holstein cows in a crossover design experiment with 28 d periods. Treatments, top dressed at 56 g per head/d, were Diamond V XP™ Yeast Culture and control (mix of dry ground corn and soybean meal). A common base diet was fed to all animals from d 1 through 26 of each period followed by a two-day dietary challenge in which finely ground high moisture shelled corn (HMC) replaced dry ground shelled corn (DC) in the base diet on an equal DM basis. Milk fat concentration decreased from 3.31% to 3.03% for cows fed the control treatment when challenged with HMC compared to DC but remained unchanged (mean = 3.33%) during the dietary challenge for the YC treatment (interaction P = 0.10). This, combined with numerical differences in milk yield among treatments, resulted in significant interactions (P < 0.03) of main effects of YC supplementation and diet fermentability for yields of 3.5% FCM, milk fat, and SNF. Fat corrected milk yield was decreased by the HMC challenge from 38.5 to 37.0 kg/d for the control treatment but was increased from 38.0 to 40.0 kg/d for the YC treatment. Yields of milk fat and SNF followed the same trend. No treatment interactions were observed for any measure of ruminal pH, total or individual VFA concentrations in ruminal fluid, acetate to propionate ratio, or individual fatty acid isomers in milk fat (P > 0.15). Although DMI was not affected by YC, meal frequency (# of meals/d) tended to be reduced by the YC treatment (P = 0.08). The YC treatment decreased ruminating time (P = 0.05) and number of chews per day (P = 0.04) by decreasing the number of ruminating bouts from 15.7 per day for control to 12.8 per day for YC (P < 0.001). The mechanism by which YC increased milk fat concentration and yield when cows were challenged with a highly fermentable diet requires further investigation.

Key Words: Lactating Cow, Rumination

164 The effect of yeast culture and enzymatically hydrolyzed yeast supplementation on performance of dairy cattle. J. E. Nocek*[1], J. Oppy[2], and M. G. Holt[2], [1]*Spruce Haven Farm and Research Ctr*, *Auburn, NY*, [2]*Varied Industries Corporation*, *Mason City, IA*.

One hundred and fifty multiparous cows were balanced to one of three treatment groups (2 pens/trt) according to previous lactation 305d ME to evaluate yeast culture (YC) and enzymatically hydrolyzed yeast (EHY) supplementation on production performance in dairy cattle. Cows entered the groups at calving and remained through 14 weeks postpartum. Groups were randomly assigned throughout the barn. Pens were identical in layout and each pen contained an exit alley so that it would not interfere with an adjacent pen when animals were moved for milking. The three treatments were: Control: no YC or EHY, YC: same as control with YC (Amax, 28g/d), and YC-EHY: same as control plus YC and EHY manufactured as a combined supplement (Celmanax, 28g/d). Mean group dry matter intake was similar across treatments. Milk yield variables were affected by treatment (P<.01). Cows supplemented with YC and YC-EHY produced more (P<.01) milk than control cows (41.9, 42.1 and 40.5kg, respectively). There was no difference between YC and YC-EHY. These same significant production differences were revealed for 3.5 FCM and ECM. Milk fat,

SNF or lactose percentages were not affected (P>.05) by treatment. However protein percentage was higher (P<.01) for cows supplemented with YC-EHY than YC and control (2.98, 2.93 and 2.91%) with control and YC supplemented cows not being different than either. Differences in fat, protein and SNF yields were primarily reflective of milk yield (P<.05). There was no effect of treatment on MUN, with all treatments ranging from 11.1-11.4. Somatic cell count was higher (P<.01) for cows supplemented with control and YC compared to YC-EHY. These results demonstrate that cows supplemented with YC produced more milk than non supplemented cows and supplementing YC with EHY as a combined manufactured supplement increased milk protein percentage.

Key Words: Dairy Cattle, Yeast Culture, Hydrolyzed Yeast

165 Effect of pasteurized waste milk, medicated milk replacer, mannan oligiosaccharide and enzymatically hydrolyzed yeast on neonatal calf performance. J. E. Nocek*[1], J. Oppy[2], and M. G. Holt[2], [1]*Spruce Haven Farm and Research Ctr*, *Auburn, NY*, [2]*Varied Industries Corporation*, *Mason City, IA*.

This study was conducted to determine the effect of: 1) pasteurized waste milk (PWM) with no antibiotic vs. medicated milk replacer (MR) 2) mannan oligosaccharide (MOS) and enzymatically hydrolyzed yeast (EHY) sources and 3) two levels of liquid EHY on grain intake, growth and fecal scores of neo-natal calves. One hundred and twenty-five female Holstein calves were randomly assigned to the following treatments at birth: Control: PWM, MR: MR with antibiotics (North American Nutrition Companies, Lewisburg, OH), LEHY4 and 8: Liquid Celmanax at 4 or 8ml/d (Varied Industries Corporation, Mason City, IA) and DMOS: Dry MOS (Bio-MOS, Milk-Pak at 14 g/d, Altech, Inc, Nicholasville, KY). Calves were removed from their dams and fed pooled colostrum within 2h of birth. Calves remained on respective treatments 42d and abruptly weaned. All calves received the same calf starter from day one. Calves were housed in individual calf hutches. Body weights and wither heights were recorded at trial initiation, day 21 and 42. Calf starter offering and refusals were recorded daily. Fecal consistency scores (FCS) were recorded for each calf daily. Calves receiving DMOS consumed more grain during the first 5wk on treatment than those receiving MR, with others not being different. There were no differences (P>.10) among treatments for total starter intake during wk 6, There were no differences (P>.10) among treatments in growth performance parameters measured. During wk 1, treatment had no effect on FCS. However, during wk 2, calves receiving MR had a higher (P<.01) FCS than other treatments. During wk 5, those receiving MR had higher (P<.01) FCS than those receiving LEHY4, however, neither were different from the other treatments. The overall 6 wk mean showed calves receiving MR to have a higher (P<.01) FCS than other treatments. This study showed in environments of low disease challenge, the use of enteric antibiotics or the addition of MOS and EHY products may not be warranted.

Key Words: Neonatal Calves, Pasturized Milk, Hydrolyzed Yeast

166 Effects of feeding rumen-protected choline (RPC) on lactation and metabolism. F. S. Lima*[1], M. F. Sa Filho[1], L. F. Greco[1], F. Susca[1], V. J. A. Magalhaes[1], J. Garrett[2], and J. E. P. Santos[1], [1]*Veterinary Medicine Teaching and Research Center, University of California Davis*, *Tulare*, [2]*Balchem Corporation, Animal Nutrition & Health*, *New Hampton, NY*.

Objectives were to determine the effects of feeding RPC on lactation and metabolism in dairy cows. In Experiment 1 (E1), 369 cows were fed 15 g/d of RPC (Reashure, Balchem) from 25 d prepartum to 80 d in milk (DIM). In E2, 578 primigravid cows were fed 15 g/d of RPC in the 21 d prepartum. Blood was sampled from 80 cows in E1 and 47 cows in E2, and analyzed for concentrations of nonesterified fatty acids (NEFA) and glucose at 1, 14 and 21 DIM. Blood from all cows was analyzed for concentrations of 3-OH-butyrate (BHBA) at 1 and 14 DIM. Subclinical ketosis was considered when BHBA was greater than 1.0 mMol/L. Hepatic tissue from 46 cows in E1 sampled at 8 DIM was analyzed for concentrations glycogen and triglycerides. Body condition was scored at enrollment, 1, 30, 60, and 90 DIM in E1, and at enrollment and calving in E2. Monthly yields of milk and milk components in E1 and weekly yields of milk in E2 were measured for 90 DIM. Prepartum DM intake was similar (P>0.15) between treatments and averaged 12.5 and 10.5 kg/d for E1 and E2, respectively, but intake tended (P = 0.10) to be greater for cows fed RPC (23.9 vs 22.6 kg/d) in E1. In E1, yields (kg/d) of 3.5% FCM (44.6 vs 42.8), ECM (40.1 vs 38.5), and milk fat (1.61 vs 1.52) were greater (P<0.05), and of milk (43.1 vs 42.1) and true protein (1.21 vs 1.17) tended (P=0.08) to be greater for RPC than control. Energy output in milk was greater (P=0.03) for RPC than control (30.0 vs 28.8 Mcal/d), although milk NEL content was similar and averaged 0.70 Mcal/kg. In E2, milk yield tended (P=0.07) to be greater for RPC than control (28.7 vs 27.9 kg/d). Body condition was improved (P =0.01) postpartum for RPC in E1. Concentration of glucose tended to be greater (P=0.10) in E1 and of NEFA was smaller (P=0.05) at calving in E2 for RPC compared with control. Prevalence of subclinical ketosis tended (P=0.07) to be smaller at calving in all cows (28.5 vs 37.2%) and was smaller (P=0.05) in multiparous cows (22.1 vs 40.0%) fed RPC in E1, but did not differ between treatments in E2. Feeding RPC improved lactation and metabolism of dairy cows, but benefits were enhanced when it was fed prior to and after calving.

Key Words: Choline, Dairy Cow, Subclinical Ketosis

167 Effect of feeding Fermenten® on the productivity of cows fed different concentrations of sucrose. G. B. Penner* and M. Oba, *University of Alberta*, *Edmonton, Alberta, Canada*.

A study was conducted to determine the effect of feeding Fermenten® on the productivity of lactating Holstein cows fed diets differing in sucrose concentration. We hypothesized that Fermenten® would increase productivity with this response being more prominent when fed in a high sucrose diet. Eight multiparous ruminally cannualted cows (163 ± 55 DIM) were used in a replicated 4 × 4 Latin square design with 21-d periods. Treatments were arranged in a 2 × 2 factorial arrangement with the main effects of Fermenten® inclusion (FERM vs. control) and dietary sucrose concentration (6.5 vs. 2.0%). Diets were formulated to contain 18.7% CP, 23.2 % forage NDF and were offered ad libitum. Cracked corn replaced sucrose for the low sugar diets, and urea and soybean meal replaced Fermenten® in the control diets. Treatments did not affect DMI and averaged 22.8 kg/d. Significant interactions were detected for milk yield, milk component yields and BCS ($P \leq 0.05$). For cows fed low sucrose diets, FERM treatment increased milk yield (26.4 vs. 24.1 kg/d), milk fat yield (0.92 vs. 0.82 kg/d), and milk CP yield (0.91 vs. 0.83 kg/d), but decreased BCS gain (0.08 vs. 0.25/21d) compared to control whereas, cows fed

a high sucrose diet without FERM increased milk yield (26.4 vs. 24.3 kg/d), similar milk fat yield (0.91 vs. 0.85 kg/d), and milk CP yield (0.86 vs. 0.90 kg/d), but decreased BCS gain (0.06 vs. 0.19 /21d) compared to FERM. There was a tendency for an interaction (P = 0.07) for plasma glucose concentration; for cows fed low sucrose diets, FERM increased plasma glucose concentration compared to the control (65.23 vs. 64.58 mg/dl) but cows fed the high sucrose diet without FERM had higher plasma glucose concentration compared to cows fed FERM (67.14 vs. 64.96 mg/dl). In this study, effects of FERM supplementation had variable effects on nutrient partitioning in lactating dairy cows depending on the dietary sucrose concentration. Contrary to the hypothesis, high sucrose diets may not optimize the utilization of Fermenten®.

Key Words: Fermenten, Sucrose, Milk Production

168 Effect of monensin feeding and withdrawal on ruminal populations of individual bacterial species in cows fed high-starch diets. P. J. Weimer*[1,2], D. M. Stevenson[1], D. R. Mertens[1], and E. E. Thomas[3], [1]*United States Department of Agriculture*, *Madison, WI*, [2]*University of Wisconsin*, *Madison*, [3]*Elanco Animal Health, Inc.*, *Greenfield, IN*.

Monensin is known to improve ruminant animal production, purportedly by inhibition of H_2-producing Gram-positive bacteria, yet there is no *in vivo* evidence for shifts in populations of specific microbial taxa. We used real-time PCR with relative quantification to assess the fraction of 16S rRNA gene copy number (F) attributable to *Prevotella* and to each of 13 classical, well-studied ruminal bacterial species in rumen contents from 2 lactating dairy cows fed a TMR containing primarily alfalfa silage, corn silage, and ground high-moisture corn. Diets averaged 30% NDF, 41.1 % NFC (26.8% starch) and 17.4% CP (DM basis). PCR was conducted on DNA from rumen samples collected 6 h after feeding on 2 successive days prior to monensin feeding, after 28 d of monensin feeding (at 0.014 g/kg of diet DM), and at six weekly intervals after monensin withdrawal. Mean values of F attributable to genus *Prevotella* increased ($P < 0.05$) from 41.8% without monensin to 49.2% with monensin, and declined to 42.5% after monensin removal. Less than 10% of the *Prevotella* were present as classical ruminal species *P. rumincola*, *P. brevis*, or *P. bryantii*. Mean values of F attributable to 4 cellulolytic species and 4 starch- or dextrin-fermenting species were not altered ($P > 0.10$) upon monensin feeding or withdrawal. Mean values of F attributable to two biohydrogenating species (*Megasphaera elsdenii* and *Butyrivibrio fibrisolvens*) were low (< 0.4%) and declined several-fold in response to monensin, in accord with observed decreases in milk fat. No changes were observed in mean values of F for a third biohydrogenating species, *Eubacterium ruminantium*. The 13 species together contributed <10% of the bacterial 16S gene copy number. The data suggest that monensin in high starch diets does not suppress populations of classical ruminal Gram-positive bacteria, though it may affect bacteria involved in biohydrogenation of lipids that regulate bovine mammary lipogenesis.

Key Words: Monensin, PCR, Rumen Bacteria

169 Effects of nitroethane and monensin on ruminal CH_4 production and nitro-degrading bacterial populations in vitro. H. Gutierrez-Bañuelos*[1], R. C. Anderson[2], G. E. Carstens[1], L .O. Tedeschi[1], E. Cabrera-Diaz[1], T. R. Callaway[2], and D. J. Nisbet[2], [1]*Texas A&M University*, *College Station,*, [2]*USDA/ARS, Food & Feed Safety Research Unit*, *College Station, TX.*

The objectives of this study were to examine the effects of nitroethane (NE) and monensin (M) on methane production, NE-degradation and NE-degrading bacterial populations using a consecutive batch culture technique. Treatments included rumen fluid, basal medium and 0.2 g of ground alfalfa, supplemented with water (Control; C), 4.5 µmol NE (1NE), 9 µmol NE (2NE), 5 µmol M (M), and 9 µmol NE plus 5 µmol M (2NEM) in triplicate. Treatment cultures were incubated at 39°C under H_2:CO_2 (1:1) and tranferred at 24 h intervals in 16 incubation series. Methane production was determined after series 1, 2, 3, 6, 10, 13 and 16, NE degradation after series 1, 2, 3, 6 and 10, and most probable number of NE-degrading bacterial populations after series 6. Daily CH_4 production was affected ($P<0.01$) by treatment, series, and treatment by series interaction, with accumulations averaging 13.65, 2.93, 1.16, 0.80 and 0.79 after the first and 7.47, 2.93, 0.92, 0.87, and 0.79 ± 0.4 µmol/ml after the 16th incubation series for C, M, 1NE, 2NE and 2NEM, respectively. Nitroethane containing treatments (1NE, 2NE, 2NEM) maintained methane production at low levels for all incubation series. Monensin treatment had a quadratic pattern in which methane levels initially declined but increased ($P < 0.01$) after series 13. Effects of treatment, series, and treatment by series interaction were observed ($P < 0.01$) on NE degradation. Residual NE concentrations were lower for 1NE than 2NE or 2NEM treatments during the first and tenth series (0.35, 0.73, and 1.06 for the first and 0.27, 1.02, and 0.95 ± 0.4 µmol/ml for the tenth, respectively. Most probable numbers of NE-reducing bacteria were increased ($P<0.01$) in 1NE and 2NE (6.9 and 5.9 $\log_{10}$ cells/ml, respectively) compared to those in C, M and 2NEM treatments (<2.5 $\log_{10} \pm 0.8$ cells/ml). These results confirm the CH_4-inhibiting activity of NE and suggest that ruminal adaptation of bacteria to NE is likely due to an enrichment of NE-reducing bacteria. The results further demonstrate that ruminal bacteria adaptation may be overcome with 2NE, and that M treatment negatively affected NE-reducing bacteria populations.

Key Words: Methane, Monensin, Nitroethane

170 Effect of monensin concentration in starter feed on feed intake and growth of young dairy calves. E. E. Thomas*, *Elanco Animal Health*, *Greenfield, IN*.

Monensin is an ionophore cleared by FDA for increasing daily gain and prevention and control of coccidiosis in growing cattle including those maintained in a dry lot. The objective of the 3 trials was to determine the effect of monensin concentration in starter feed (33, 50, 66 ppm) on feed intake and daily weight gain in newborn Holstein dairy calves. Milk replacer was fed at a rate of 0.86 kg/hd/d in trial 1 and 0.45 kg/hd/d in trials 2 and 3. Calves were weaned at 5 or 6 wks of age and were individually housed for 12 wks (trial 1, 72 heifers) or 8 wks in trials 2 (100 bulls) and trial 3 (48 bulls). In trial 1, calves were then grouped and fed a common grower feed (38 ppm monensin) for 8 wks. During that time, 4 pens per original treatment group were maintained. Trials were statistically analyzed separately. Starter feed intake and daily gain (kg/d) during the individual housing period for 33, 50, and 66 ppm treatments, respectively, by trial were: (trial 1, 1.32, 1.18, 1.32; 0.67^{ab}, 0.63^{b},0.71^{a}) (trial 2, 1.32^{a}, 1.22^{b}, 1.22^{b}; 0.56, 0.52, 0.54) (trial 3, 0.82, 0.77, 0.77; 0.59, 0.57, 0.56). In trial 1, feed intake and daily gain (kg/d) following grouping for the original 33, 50, and 66 ppm treatment groups, respectively, were: 3.90, 3.86, 3.95;

1.03, 1.05, and 0.97. The FDA cleared dose range for controlling coccidiosis is .06 to 0.45 mg/kg body weight in calves. At the end of 8 wks in trial 3 the monensin intake (mg/kg body weight) was 0.19, 0.26 and 0.36 for the 33, 50, and 66 ppm treatments, respectively. In conclusion, during the individual housing period there were no differences in feed intake between 33, 50 and 66 ppm treatment groups with the exception of trial 2 in which 33 ppm calves ate more (P<.05) than 50 or 66 ppm calves. There were also no differences in growth rate between 33, 50 and 66 ppm treatment groups with the exception of trial 2 in which calves fed 66 ppm grew faster (P<.05) than calves fed 50 ppm but similar to the 33 ppm calves. After grouping in trial 1, there were no differences in feed intake or daily weight gain.

Key Words: Rumensin, Monensin, Growth

171 Deactivation of aflatoxin B1 in animal feed by using a selected bentonite. G. Schatzmayr*[1], S. Fruhauf[2], and E. Vekiru[2], [1]*BIOMIN Research Center*, *Tulln, Austria*, [2]*Christian Doppler Laboratory for Mycotoxin Research*, *Tulln, Austria*.

Aflatoxin B1 (AFB1) is a mycotoxin produced by *Aspergillus* fungi on a great variety of agricultural commodities. AFB1 impairs health of different animal species. In dairy cows this hepatotoxic and carcinogenic toxin can be metabolized to aflatoxin M1 and secreted into milk. It is known that hydrated sodium calcium aluminosilicates (HSCAS) in animal feed can reduce the adsorption of AFB1 in the gastrointestinal tract. The aim of this study was to select an enterosorbant out of more than 60 bentonites with a high selectivity for AFB1. As reference material in this screening study a commercially available HSCAS and charcoal were used. The evaluated chemisorption index (Cα) showed that bentonites can bind AFB1 very strongly, a fact that indicates an adsorption process due to chemisorption. From the tested bentonites only a few reached or exceeded the Cα value and the maximal adsorption capacity (Qmax) of the reference binders. Tests in real gastric juice and in vitamin solutions were used to determine selectivity of the binding agents. Charcoal proved to be a very unselective binder that definitely binds vitamins to a greater extent than bentonites. AFB1 adsorption of the reference materials was clearly decreased in real gastric juice. Only a few of the investigated binders performed better than the reference materials. This showed us that not only AFB1 binding capacity can be used as selection criterion for clay minerals as feed addtives but also parameters like binding behavior in complex environments (gastrointestinal juice) and binding of essential nutrients have to be considered. Mineralogical studies did not lead to any parameter which could be used to correlate AFB1 adsorption. One of the most promising materials was part of a feeding trial with dairy cows aiming to determine carry over of aflatoxin into milk (3 groups: control diet + AFB1; control diet + AFB1+ material at two concentration levels). The addition of the bentonite to the diet significantly reduced the milk aflatoxin M1 content at both concentrations (20g per cow and day and 50g, respectively). Feed intake and milk production were not negatively influenced by the bentonite.

Key Words: Aflatoxin, Mycotoxin, Deactivation

172 Adding liquid feed while reducing non-fiber carbohydrates (NFC) enhances feed intake and milk fat production. J. L. Firkins*, C. Reveneau, L. E. Gilligan, and A. Sprunger, *The Ohio State University*, *Columbus*.

Liquid feeds (LF) reduce forage particle sorting, improve palatability, and increase energy density of TMR. However, excess sugars could promote rumen acidosis or could reduce milk fat production, particularly if combined with Rumensin (R). Our objectives were to add LF at two concentrations while reducing NFC concentration to optimize the use of LF in dairy rations. Diets had 30% corn silage, 15 % chopped alfalfa hay, and 8% whole cottonseeds (21% forage NDF). A control was balanced for 40% NFC. Two diets with 3.25% LF (DM basis) had 40 or 37 % NFC. Two more 37% NFC diets had 6.5% LF, but the second also had R at 11.5 g/909kg of DM in the TMR. Diets contained similar CP to formulations (17.3%). Compared with formulations, forage NDF was 1% unit lower; and NFC, 1% higher. Treatments lasted 12 wk after an initial 2-wk covariate period. Treatment n = 8 multiparous and 4 primiparous Holsteins. Although repeated measures were used in a mixed model (random effect of cow), no treatment x time interactions were detected. Means were separated by protected LSD. Milk protein % was higher (P<0.01) for control (2.93%) than the LF diets (averaged 2.84%), but protein yield, milk production, and milk fat were not affected (averaged 1.15 kg/d, 40.4 kg/d, and 3.33%). Production of milk fat, 3.5% FCM, and energy-corrected milk (ECM) were higher (P<0.09) for cows fed 3.25% LF in 37% NFC diets than the control or 3.25% LF diet with 40% NFC. ECM was 26.2, 25.7, 27.4, 26.5, and 26.2 kg/d, respectively, for control, 3.25 % LF in 40% NFC and 37% NFC diets, and 6.5% LF in 37% NFC diets without or with R. The DMI were 23.9, 23.9, 25.2, 25.9, and 24.5 kg/d, respectively. DMI was greater (P<0.10) when 3.25 and 6.5% LF was added to the 37% NFC diets than the control. The ECM/DMI was not different (averaged 1.10). Because total tract OM digestibility was not affected, LF appear to be best used when replacing starch and with decreased NFC to maintain comparable rumen carbohydrate digestibility. LF did not depress milk fat, even at high levels or when R was included.

Key Words: Liquid Feed, Milk Fat, Dairy Cattle

173 The role of the NSF/National Science Digital Library in the dissemination of science, technology, engineering and mathematics information and in support of innovations in teaching and learning. L. Salisbury*[1,2], [1]*University of Arkansas Libraries*, *Fayetteville*, [2]*National Science Digital Library*.

The National Science Digital Library (NSDL) was created by the National Science Foundation to provide organized access to high quality resources and tools that support innovations in teaching and learning at all levels of science, technology, engineering, and mathematics (STEM) education. NSDL was established by the National Science Foundation (NSF) in 2000 as an online library where users can find exemplary resources to assist them in STEM instruction, education and research. The digital library provides an organized point of access to high quality STEM content that is aggregated from a variety of other digital libraries, NSF-funded projects, and NSDL-reviewed web sites. In this context, NSDL serves both as a focal point for access to and the dissemination of research results. This presentation will highlight key resources in the NSDL that will be useful in poultry and animal science research, instruction and education. It will also showcase the huge set of quality resources for teaching and instruction in general biology. The services and tools that enhance the use of the NSDL content in a variety of contexts will also be explored. This presentation will also introduce the audience to ways of participating in the National Science Digital Library, including methods for contributing resources and collections.

Key Words: National Science Digital Library, Science Information, Technology Information

174 The importance of images to the pork industry. D. J. Meisinger*, *US Pork Center of Excellence*, *Ames, IA*.

The mission of the US Pork Center of Excellence is to add value to the pork industry by facilitating research and learning for U.S. pork producers through national collaboration. The USPCE is bringing states together in a collaborative mode to accomplish many things in research, teaching and extension. The newest tools include the Pork Information Gateway or PIG which is a virtual library of resources and information on all aspects of swine and pork. PIG has peer-reviewed fact sheets, numerous other information pieces, about 2000 frequently asked questions, an events calendar, a glossary and a small image library. The latter contains only about 80 high resolution images that are all acceptable for any audience. The facilities pictures, for instance, show white buildings, blue skies, blue lagoons, etc. Because the images are all high resolution, they lend themselves to print quality for publications while also working well on presentations. Another tool available only to educators is the PIG Media Asset Portal or PIGMAP. This tool has over 4500 images but is held closely. Many of the images of unhealthy pigs or environmental situations would not be acceptable used outside of our industry. That is the reason for restricting the site only to registered users. The images are classified according to one of sixteen different categories. The intent is to not only expand the image inventory but also to add other materials such as PowerPoint presentations, movie clips, audio clips, and activities. Educators have found the image library, even in its rudimentary state, an excellent tool for developing classroom lectures or presentations for producer meetings, developing a newsletter, graphically demonstrating to make a point, etc. Equipping educators has an expanded effect due to the fact that the educator has a reach throughout the industry having exposure to many pork producers. The USPCE has the philosophy in all its areas of work that the more venues in which materials are presented, the better the opportunity to reach a maximum number of producers. To meet this end, there is an effort to transfer as many of the innocuous photos as possible into the Animal Science Image Gallery.

Key Words: Swine Images, Pork Information Gateway, PIGMAP

175 Image coupling – simplifying and linking information for enhanced learning. S. Gerard[1], A. C. Oki[2], and P. L. Senger*[2], [1]*Oei Graphics*, *Bellevue, WA*, [2]*Current Conceptions, Inc.*, *Pullman, WA*.

Teaching concepts in reproductive science usually follows a sequence in which anatomy is presented first, followed by hormonal responses by the target tissue. Although this sequence is well accepted, it does not easily allow anatomy and hormone responses to be coupled into concise, visually powerful images. Images in reproductive science generally follow two primary forms: photographs of anatomical specimens and two–dimensional graphics that are intended to convey time-related mechanisms and events. Complex two–dimensional graphics typically are presented ″all–at–once″ with no defined starting or ending point. Such images are often visually overwhelming when presented on a screen because there is too much information presented in a short period of time. We have developed a series of PowerPoint images (n = 1,100) that present complex anatomical and graphic information in a step–wise, animated fashion. This approach allows each graphic to be presented with a defined beginning and a defined conclusion and the instructor can ″build″ complex images in a logical, step–wise sequence, thus simplifying them. Further, the instructor can ″back–up″ to reemphasize or clarify points. We have also utilized Flash animation to further enhance the explanation. For example, ovarian structures can be visually added to the graphic so that the viewer observes an image that contains anatomical structures, hormone profiles and responses to hormones in one well–sequenced, step–animated series of images. Application of this technology can facilitate learning in a wide variety of disciplines. Image ″building″ and coupling was used for two semesters in a reproductive science course involving over 140 students. While not quantified, the following changes in student behavior were observed: 1) fewer students took notes and concentrated on the content of the lecture; and 2) questions transitioned from simple clarification of minor points to clarification of entire concepts.

Key Words: Image, Reproductive Science, Education

176 Digital Image Gallery to assist learning animal science: Photos and illustrations solicited. J. W. Riesen*[1], H. D. Hafs[2], G. K. McCone[3], P. A. Schoknecht[4], and M. R. Stokes[5], [1]*University of Connecticut*, *Storrs*, [2]*Rutgers University*, *New Brunswick, NJ*, [3]*National Agricultural Library*, *Beltsville, MD*, [4]*Wagner College*, *Staten Island, NY*, [5]*University of Maine*, *Orono*.

To assist teaching baccalaureate level Animal Sciences, we are accumulating digitized images and animations at http://

anscigallery.nal.usda.gov. Sections for Beef Cattle, Companion Animals, Dairy Cattle, Ethology, Horses, Nutrition, Other Species, Pork Industry, Poultry, Reproduction, and Sheep and Goats are already installed. The potential exists to add additional sections. Instructors, researchers and graduate students everywhere are encouraged to contribute their images. Submitted images with descriptions and metadata are peer reviewed to insure accuracy and optimize their use in learning. Submitters are giving their permission to use the images for teaching purposes, but have the option of requiring a credit line when they are used. Submitters also have the option to put images in the public domain. ASAS manages the peer review process. The National Agricultural Library (NAL) manages the Image Gallery website where the images are available in perpetuity and without cost. The gallery uses the NAL thesaurus, includes a glossary, and is searchable either by keyword or by advanced search methods. Images can be downloaded in one of several resolutions. This co-operative effort makes free high quality, peer reviewed images easily available to instructors without the danger of copyright infringement. As of 2/2007 over 300 images are available on the website with more in the process of submission and review.

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Key Words: Image Gallery, Teaching, Learning

177 ASAS operational structure for the animal science image gallery. M. C. Wulster-Radcliffe*, *American Society of Animal Science*, *Savoy, IL*.

The goal of the Animal Science Image Gallery is to continue to develop a digital image database housed on servers at the National Agricultural Library (NAL), to assist animal science instructors and their students. Animations, videos, data sets, and other teaching tools are solicited, particularly when single images are inadequate for difficult concepts. The NAL indexing system ensures that adequate metadata are included for each image. NAL will make the images available in perpetuity without charge to those who submit or use the images. While NAL will maintain the Image Gallery in perpetuity, they are not prepared to assess new images arising out of new discoveries or technical advances. American Society of Animal Science (ASAS) members possess the expertise to select new images for the Gallery, and they have peer review experience. Therefore, ASAS will assume logistical management of the Image Gallery in October 1, 2007. ASAS will establish an Image Gallery Editorial Board within ASAS. The Editorial Board will be constituted and operated similarly to that for the Journal of Animal Science. The Editorial Board for the Image Gallery will fall under the venue of the ASAS Publications Committee. Initially, the Board will consist of the current Image Gallery editors, as some have volunteered to serve beyond September 30, 2007. Each Section Editor will be encouraged to form a Steering Committee to a) set policy and b) solicit images. To ensure quality, each image and its metadata will continue to be peer-reviewed, much as papers are peer-reviewed for a scientific journal. The Gallery web site http://anscigallery.nal.usda.gov/ currently has instructions for submission and review of images. The major changes over the next several months will lead to more formal incorporation of ASAS review policies. With volunteer section editors and reviewers, the Image Gallery adopted the journal paper review model. The current volunteer editors and reviewers have validated this model. As NAL will provide the computer resources for the Gallery, the main responsibility for ASAS would be recruiting and organizing editors.

Key Words: Image Gallery, Teaching

178 The OSU Breeds of Livestock Library. D. S. Buchanan*, *Oklahoma State University*, *Stillwater*.

At about the time that the internet started to become part of the life of animal scientists, we had the idea that people might enjoy a resource on breeds of livestock. The first thought was to make a library on CD but, at the time, making a master CD was prohibitively expensive (an indication of just how much times have changed). So we turned to the internet as a location for this library. We contacted all of the breed associations that we knew anything about and asked for a description of the breed and some photographs. Response was slow but we started presenting the breeds for which we had information. Some most popular breeds did not send us information and we started getting emails from people who wondered why we did not have some of these breeds. In order to illustrate that we did know that these breeds existed, we constructed a site for each of them and just placed a statement in each site requesting information. Several breed associations contacted us with a query as to why we had not contacted them. We were able to tell each one that we had sent a letter but that they had never responded. Many responses followed quickly. The library grew rapidly and now contains more than 1000 breeds of cattle, swine, horse, sheep, goats, chickens, turkeys, ducks and geese. The library is one of the most heavily used sites at our university. Several of the pages receive in excess of 10000 hits per month. Many of the most popular pages are horse breeds (e.g. Arabian, Quarter Horse, Palomino). The pages include a link for comments. There are typically six to ten comments per day. Some of the comments are requests to use the images in other venues. We allow use of the images for educational, not-for-profit purposes. We receive a few comments every week that are asking us to update a page. In addition, a substantial portion of the comments are just random comments such as ″I like horses″ or ″Eating animals is cruel″. The most interesting comments are from teachers and students. We have realized that these pages are used in schools across the United States and in other countries. Such schools are, in many cases, in urban areas and these pages are providing an opportunity for students to learn about Animal Agriculture.

Key Words: Breed, Livestock, Internet

179 Images for animal breeding, archives, extension, and poultry. D. S. Buchanan*[1], G. E. Dahl[2], J. B. Hess[3], and G. K. McCone[4], [1]*Oklahoma State University*, *Stillwater*, [2]*University of Florida*, *Gainesville*, [3]*Auburn University*, *Auburn, AL*, [4]*National Agricultural Library*, *Beltsville, MD*.

Presently, how vision contributes to cognition is a major field for research in psychology and neuroscience. Nevertheless, good teachers have understood that visuals facilitate learning, and the advantages of images for learning in less structured environments such as outreach likely exceed those used in classrooms. While the on-line Dairy courses offered for credit by the University of Illinois use some real-time audio-visual interactions between instructors and students, images are critical because the majority of the learning is visual without active

interactions. Increasingly, those who specialize in archival information enhance their holdings with images. For example, the liberal use of images in the holdings within the Animal Welfare Information Center (AWIC, http://awic.nal.usda.gov/) at the National Agricultural Library (NAL) significantly enhances information transfer. As another kind of example, NAL now facilitates use of many of their holdings such as those in AWIC through the National Digital Library for Agriculture which provides easy access to up-to-date authoritative agricultural information, data, and services for consumers, policymakers, researchers and other agricultural specialists, farmers and other agribusinesses, libraries, educational institutions, and the general public. Images have proven to be especially useful to preserve historical information, such as the Poultry historical images now being assembled. The "Breeds of Livestock" and "Breeds of Poultry" web sites (http://ansi.okstate.edu/breeds/) also are examples of how images efficiently enhance cognition.

Key Words: Vision, Images, Learning

Graduate Student Competition ADSA Northeastern Branch - ASAS Northeastern Section

180 The effect of microbial inoculants on the fermentation and aerobic stability of orchard grass silage. C. M. Klingerman*, R. J. Schmidt, W. Hu, E. E. McDonell, and L. Kung, Jr., *University of Delaware*, *Newark*.

Microbial inoculants were tested for their effects on the fermentation and aerobic stability of silage. Wilted orchard grass (about 38% DM) was chopped and treated with A) nothing, B) a "grow up" culture (*Lactobacillus lactis* and *L. plantarum* AberF-1 with the ability to ferment fructose), C) a low dose of a dry formulation of B, D) a high dose of a dry formulation of B, E) Sil-All 4 × 4 inoculant (*L. plantarum*, *Pediococcus acidilactici*, *Enteroccus faecium* and *Bacillus pumilis* and amylase enzymes), F) Pioneer 1127 inoculant (*L. plantarum* and *E. faecium*), G) Biomax Multipurpose inoculant (*L. plantarum* and *P. pentosaceus* and H) *L. buchneri* and *P. pentosaceus*. The sources of products were: B, C and D (ABS Global, DeForest, WI), E (Alltech, Nicholasville, KY), F (Pioneer, Johnston, IW), G (Chr. Hansens Biosystems, Milwaukee, WI) and H (Lallemand, Milwaukee, WI). Silages were packed in vacuum/heat-sealed pouches. Data were analyzed separately for each time point using the PROC GLM procedure of SAS for a completely randomized design. After 90 d of ensiling, the concentrations of lactic (ave. 6.04%) and acetic (ave. 0.43%) acids were higher and lower, respectively, in silages B through G when compared to that of A (4.71% and 1.93%) ($P < 0.05$). Silages B through D had less NH3-N (ave. 0.07%) than A and H (0.14%) ($P < 0.05$). Silage H had the least lactic acetic (1.53%) but most acetic acid (6.58%) compared to all other silages ($P < 0.05$). Silages B through G had more yeasts (> 5.5 log cfu/g) than did A (2.76 log cfu/g) and H (0.85 log cfu/g). Aerobic stability was worse for silages B through G (ave. 42 h) but better for H (400 h) compared to A (178 h) ($P < 0.05$). Dry matter recovery was lowest for H ($P < 0.05$) and similar among other silages. Homolactic acid-based silage inoculants can improve silage fermentation but can make aerobic stability worse. An inoculant containing *L. buchneri* had the best aerobic stability but lowest DM recovery of all treatments. A "grow up" inoculant with the ability to ferment fructose improved the early rate of fermentation but final silage quality was generally similar to that from other treatments after storage.

Key Words: Silage, Forage

181 Effects of feeding alfalfa silage at two levels with and without Rumensin to high producing Holstein cows on animal performance. C. M. Martinez*, Y. H. Chung, T. W. Cassidy, V. Ishler, K. S. Heyler, and G. A Varga, *The Pennsylvania State University*, *University Park*.

Eight multiparous high producing Holstein cows (BW=699 kg ±13; DIM=158 d ±4.5) were used in a replicated 4x4 Latin Square design with a 2x2 factorial treatment arrangement to evaluate the effects of feeding two levels of forage inclusion with and without Rumensin on dry matter intake, milk production, milk composition and blood metabolites. The diet was formulated to contain 50 or 60% forage (DM basis) in which alfalfa haylage comprised 55% and corn silage comprised 45% of the total forage in the diet. Rumensin was top dressed at a rate of 300 mg/cow/d. The length of each period was 4 wks and samples were collected during the last wk. Dry matter intake was higher ($P < 0.01$) for cows consuming the 50% forage diet than for cows consuming the 60% forage diet (29.6 vs. 27.3 kg/d, respectively). Milk yield and fat corrected milk (46.4 and 46.6 kg/day, respectively) were not affected by forage level or Rumensin in the diet. Milk fat % increased with forage level (3.39 and 3.51% for 50 and 60% forage, respectively, $P < 0.05$). However, a significant forage level by Rumensin interaction was observed showing that Rumensin decreased milk fat % for the 60% forage diet with no effect on milk fat % for the 50% forage diet. Cows consuming the 50% forage diets had higher ($P < 0.05$) milk protein % (3.12) than cows consuming the 60% forage diets (3.07). Milk protein % was lower for Rumensin-fed cows (3.07) compared to no Rumensin (3.12). Neither fat nor protein yields were affected by forage level or Rumensin. Cows consuming the 60% forage diets had a higher ($P < 0.05$) feed efficiency (1.71) when compared to the 50% forage diets (1.56). Blood glucose was higher for cows receiving 50% forage than cows receiving 60% forage (69 vs. 65 mg/dL, respectively). Results from this study suggest that higher forage levels can be achieved in dairy cow rations without affecting milk production while improving feed efficiency compared to lower forage inclusion. When feeding alfalfa silage based rations supplemented with Rumensin, milk components may be altered dependent upon forage level in the diet.

Key Words: Rumensin, Alfalfa, Forage level

182 Trans-7-octadecenoic acid decreased milk fat and altered CLA composition in milk of lactating mice. A. K. G. Kadegowda*[1], B. B. Teter[1], J. Sampugna[1], P. Delmonte[2], L. S. Piperova[1], and R. A. Erdman[1], [1]*University of Maryland*, *College Park*, [2]*Food and Drug Administration*, *College Park, MD*.

Principal component analysis of data from studies with MFD in cows has indicated that trans-7-18:1 (t-7) could be associated with regulation of milk fat synthesis. We used a lactating mouse model to compare the effects of t-7-, t-9-, t-11-18:1, t10c12 CLA (Sigma Chemicals, Co.,

St.Louis, MO), and PHVO (partially hydrogenated vegetable oil) on milk fat content and fatty acid composition. Thirty lactating C57Bl6J mice were fed a Control diet until day 6 postpartum, and were randomly assigned (n=5) to 6 treatments until day 10 postpartum. The trans-18:1 isomers or PHVO were added as 5% and t10c12 CLA was added as 1% of the calories, replacing equal parts of the oleic acid in the Control diet. Milk samples were collected on days 6 and 10 postpartum. Milk fat did not differ among groups at day 6. On day 10, milk fat percentage was 36.4, 28.1, 20.4, 26.7, 36.6 and 32.1 in mice fed Control, PHVO, t10c12 CLA, t-7-, t-9-, and t-11-18:1, respectively. Milk fat percentage was decreased by t10c12 CLA (44%; $P < 0.001$), t-7-18:1 (27%; $P < 0.001$) and PHVO (23%; $P < 0.001$). Compared to the Control (0.25g/100g), CLA were increased in milk of mice fed t10c12 CLA (1.87g/100g; $P < 0.001$) and in those fed t-11-18:1 (1.12g/100g; $P < 0.001$) due to the endogenous synthesis of c9t11. However, the greatest increase in CLA was found in mice fed t-7-18:1 (2.24g/100g; $P < 0.001$), where t7c9 was the predominant isomer representing 87 % of total CLA. PHVO treatment also increased milk CLA content (0.76g/100g; $P < 0.001$) by providing t-11-, and t-7-18:1 precursors for endogenous synthesis of CLA. The t7c9 CLA (10% of total CLA) observed in milk of mice fed diet supplemented with PHVO, confirmed the presence of t-7-18:1 in the oil. The data showed unequivocally that t-7-18:1 was converted to t7c9 CLA in mice. These results suggested that the t-7-18:1 and/or its Δ9 desaturation product may be involved in regulation of milk fat synthesis.

Key Words: Trans fatty acids, CLA, Milk fat

183 An evaluation of two methods to cover bunker silos to maintain the nutritive value of silage. E. E. McDonell*, C. M. Klingerman, R. J. Schmidt, W. Hu, and L. Kung, Jr., *University of Delaware*, *Newark*.

The objective of this experiment was to test the effect of different methods for covering corn silage in bunker silos. Three bunker silos (44 × 7 m) were filled with chopped whole-plant corn (30% DM). Immediately after filling, one half of each silo was covered with one of two methods. The first method (**A**) was comprised of a 6 mil black/white polyethylene (Up North Plastics Bunker Covers, Cottage Grove, MN), weighted down with split-tires. The second method (**B**) was comprised of a single layer of triple co-extruded film (1.77 mil) with low permeability to O_2 (Silostop, Mongralese, Italy), a protective tarpaulin, and weighted down with reusable bags filled with pea-gravel (99 × 15 cm). Method B also included a layer of the extruded film, which was placed along the length of the sidewall prior to filling. Corn silage was sampled at 5, 7 and 10 months of ensiling. Silage was sampled at three depths extending in 15.24 cm increments downward, and three widths extending in 20.32 cm increments outward from the wall. Repeated- measures mixed model was used to test the main effects of covering system, time, width, and height, along with all interaction effects. The interaction of width × treatment is shown below. Corn silage covered with method B had higher DM, NDF, pH, and butyric acid for each width away from the silo wall ($P < 0.05$) than corn silage covered with method A. This corn silage also had numerically less lactic acid compared to corn silage covered with method A. Corn silage covered by method B maintained a higher quality than corn silage covered by method A.

Table 1.

Item	Width1* A**	Width1 B***	Width2 A	Width2 B	Width3 A	Width3 B
DM,%	19.77^{e}	29.01^{abc}	23.52^{d}	29.13^{ab}	27.80^{bc}	30.33^{a}
NDF,%	62.29^{a}	46.07^{cde}	54.86^{b}	46.44^{cd}	47.87^{c}	43.00^{e}
pH	5.20^{a}	3.96^{bc}	4.22^{b}	3.76^{c}	4.04^{bc}	3.74^{c}
Lactic Acid,%	0.39^{e}	1.67^{cd}	1.09^{d}	2.21^{abc}	2.44^{ab}	2.76^{a}
Butyric Acid,%	0.22^{b}	0.07^{d}	0.39^{a}	0.02^{d}	0.21^{bc}	0.08^{d}

*Width 1 is closest to the silo wall. **A= low O_2 plastic, tarp, and gravel bags. ***B=plastic and tires. ^{abcde}Means in rows with unlike superscripts differ ($P < 0.05$)

Key Words: Bunker silo, Silage

184 Effect of level of fermentable NDF on feed intake and production of lactating ewes. M. A. Schotthofer*, M. L. Thonney, and D. E. Hogue, *Cornell University*, *Ithaca, NY*.

The objective of this experiment was to quantify the effect of level of fermentable NDF (FNDF) on DMI and production of highly productive, lactating ewes. Within one wk of parturition, 21 ewes and their triplets or twins (2.7 lambs per ewe) were penned individually in expanded metal floor pens and fed one of three diets for 6 wk. The diets were formulated to contain 15, 25, or 35% FNDF with associated decreases in nonstructural carbohydrates based upon estimated ingredient digestibility values at 1X maintenance. The 15% FNDF diet (19% NDF) contained 48.2% corn gluten feed (CGF), 44.9% corn, 2.9% calcium carbonate, 2% mineral-vitamin premix, and 2% corn oil. Soy hulls replaced 3 percentage units (PU) of the CGF and 17 PU of the corn for the 25% FNDF diet (30% NDF), and 6 PU of the CGF and 33 PU of the corn for the 35% FNDF diet (41% NDF). Chromic oxide was used as a marker to determine digestibility. Milk production was measured during wk 3 by lamb removal, oxytocin administration, and milking followed 3 h later by a second milking. Almost all ewes had sore teats by wk 4, often followed by mastitis, which was treated with penicillin and udder balm. For ewes fed the 15% FNDF diet, DMI was similar to 2007 NRC values, but DMI was substantially higher for ewes fed the 25 and 35% FNDF diets (Table 1). In line with digestibility depression from increased intake, actual FNDF values were substantially lower than the 1X maintenance values upon which the diets were formulated, but ewe and lamb gains, and milk production increased substantially as dietary FNDF increased (Table 1). These data indicate that diets for lactating ewes with 2 or 3 lambs should contain a minimum of 25 to 35% 1X FNDF in the dry matter and that diet formulation can have a marked effect on DMI.

Table 1. Effect of fermentable NDF level on lactating ewes

	FNDF, % of DM				*P*-value	
Item	15	25	35	SEM	15 vs others	25 vs 35
Number of ewes	7	7	7			
Initial ewe weight, kg	58	63	62	2.6	0.16	0.76
Final ewe weight, kg	57	67	66	3.6	0.04	0.91
DMI, kg/d	2.3	3.3	3.9	0.21	<0.01	0.07
Gain, g/d	-29	86	100	50.3	0.06	0.86
Actual DMD, %	68	61	55	1.3	<0.01	0.02
Actual FNDF, %	8	12	16	0.9	<0.01	<0.01
Milk yield, kg/d	2.6	3.1	3.6	1.23	0.32	0.56
Lambs raised	1.7	2.3	2.4	0.32	0.11	0.75
Avg lamb ADG, g/d	125	170	190	34	0.20	0,67

Key Words: Fermentable NDF, Lactating ewes, Fiber

185 The effect of *Lactobacillus buchneri* 40788 with or without *Pediococcus pentosaceus* on the fermentation and aerobic stability of corn silage made at different locations. R. J. Schmidt*, W. Hu, C. M. Klingerman, E. E. McDonell, and L. Kung Jr., *University of Delaware*, *Newark*.

Whole-plant corn (32 – 38 %DM) was chopped and treated with nothing (C), *Lactobacillus buchneri* 40788 (400,000 cfu/g) (Lallemand Animal Nutrition, Milwaukee, WI) (LB) or *Lactobacillus buchneri* 40788 (400,000 cfu/g) and *Pediococcus pentosaceus* (100,000 cfu/g) (LBC) from five locations and packed into 20-L buckets to determine their effects on silage fermentation and aerobic stability after 120 d of storage. The experiment was a randomized complete block design with main effects of inoculation (I), location (L) and I × L interaction. Data were analyzed by the GLM procedure of SAS. Dry matter recovery was different among L but unaffected by I ($P < 0.05$). Numbers of lactic acid bacteria and yeasts were greater and lower respectively, in LB and LBC than C ($P < 0.05$) and different among locations ($P < 0.05$). Numbers of *L. buchneri* (determined by real-time qPCR) were higher ($P < 0.05$) in four of five locations for LB and LBC *vs.* C (I × L interaction, $P < 0.05$) with values for the main effect of I ($P < 0.05$) being an average 6.7 log cfu/g of LB and LBC *vs.* 4.87 log cfu/g for C. Inoculation with LB or LBC raised ($P < 0.05$) silage pH and concentrations of acetic acid, 1,2 propanediol and decreased ($P < 0.05$) concentrations ethanol and water soluble carbohydrates but there was an I × L interaction ($P < 0.05$) for all of these components. Similarly, inoculation with LB (136 h) and LBC (136 h) improved ($P < 0.05$) aerobic stability compared to C (44 h) but there was an I × L interaction ($P < 0.05$). In general, locations with the largest increases in acetic acid due to LB and LBC had the greatest improvements in aerobic stability. The addition of *L. buchneri* 40788 alone or with *P. pentosaceus* resulted in similar effects on silage fermentation and aerobic stability but the effects were not consistent among locations suggesting that unknown factors in the field may alter the effectiveness of microbial inoculation

Key Words: Corn silage, *L. buchneri*, Real-time qPCR

186 Effect of weight gain and diet on insulin sensitivity in Thoroughbred geldings. R. W. Quinn*[1], A. O. Burk[1], T. G. Hartsock[1], K. H. Treiber[2], and R. C. Boston[3], [1]*University of Maryland*, *College Park*, [2]*Virginia Polytechnic and State University*, *Blacksburg*, [3]*University of Pennsylvania*, *Kennett Square*.

Altered glucose and insulin dynamics, including a reduction in insulin sensitivity (SI) have been observed in equine obesity and may contribute to the onset laminitis in susceptible individuals. The body condition score (BCS, scale 1-9) at which such changes occur is unknown. Fifteen mature Thoroughbred geldings (BW 516±13 kg, BCS 4.3±0.1) were fed hay and concentrate twice daily at 20 mcal/d above maintenance until ≥90.8 kg BW was gained (≤9 mo). During weight gain, horses were fed either a high starch (HS, NSC 57%, FAT 4%, n = 9) or a high fat/fiber diet (HF, NSC 20%, FAT 17%, n = 6). A frequently-sampled i.v. glucose tolerance test was carried out prior to treatment initiation (BASAL) and at the start (INITIAL) and end (FINAL) of weight gain. Thirty-six venous blood samples were collected from -30 to 240 min, with 300 mg/kg BW glucose injected at 0 min and 20 mIU/kg BW insulin at 20 min. The minimal model of glucose dynamics was used to estimate SI, glucose-stimulated glucose disposal (SG), the first-phase insulin response (AIRg) and the disposition index (DI). No treatment differences were found at BASAL, INITIAL or FINAL for SI, SG or DI. The AIRg was higher in HS vs. HF at FINAL (P = 0.02). The SG was higher (P = 0.002) at INITIAL vs. BASAL and FINAL for HF. It is likely that weight gain over the middle of the BCS range (BCS 4-7) has little impact on glucose and insulin dynamics. However, the higher AIRG in HS at FINAL suggests that the changes which have previously been observed in horses on high starch diets may be beginning. The higher SG in HF during INITIAL may reflect dietary adaptation to fatty acid utilization. Loss of this effect by FINAL may indicate a weight-gain associated loss of this adaptation. Because no negative changes to SI were observed in this study, the lower limit of fatness associated with metabolic problems remains unknown but most likely lies above the BCS range examined in this study.

Key Words: Equine, Insulin, Minimal model

187 Digestibility of limit fed high and low concentrate diets with corn silage as the sole forage for dairy heifers with *Saccharomyces cerevisiae*. G. J. Lascano* and A. J. Heinrichs, *The Pennsylvania State University*, *University Park*.

Restricted feeding and high concentrate (HC) diets are potential methods for growing dairy heifers. Ruminal manipulation with additives such as *Saccharomyces cerevisiae* yeast culture (YC) could alter digestibility when added to these diets. A study was designed to study effects of YC on dry matter digestibility (DMD) and N digestibility (ND). An additional objective was to evaluate effects of YC on DMD and ND added to limit-fed HC diets. A split plot design with heifer age as the whole plot and treatment as sub-plot was administered in a 4 period (21 d) 4 x 4 latin square. Eight Holstein heifers (288 ± 4 and 410 ± 2 d of age and 234 ± 15 and 409 ± 20 kg BW) were allocated to 4 treatments consisting of HC TMR (40% CS, 60% grain; 12.6% CP, 25% NDF), and a low concentrate (LC) TMR (80% CS, 20% grain; 12.3% CP, 35% NDF) without YC addition and the same treatments with YC top dressed (1 g/kg intake as fed basis). Diets were fed once/d to provide 0.22 Mcal ME intake/kg $EBW^{0.75}$. Periods consisted of 17 d adaptation and 4 d total fecal and urine collection. Urine was collected using non-invasive urinary devices attached to heifers (pH adjusted to minimize NH3 volatilization); feces were collected hourly and stored in airtight containers. DMD was different between HC and LC (75.67 vs.72.96 ± 0.7%; $P < 0.01$), and

YC addition increased DMD in both diets (74.97 vs. 73.65 ± 0.7%; $P < 0.05$). No differences were found among the 2 ages ($P > 0.3$). N intake (128.13 ± 1.85 g/d) and apparent ND were similar in all treatments. HC diets decreased fecal output on DM (1.49 vs. 1.77 ± 0.06; $P < 0.01$) and wet (10.48 vs. 7.28 ± 0.36 kg; $P < 0.01$) bases, and YC had a significant effect in both parameters ($P < 0.05$). Urine volume excretion was not different; therefore total manure output was lower for HC diets. We conclude that YC increased DMD in HC and LC diets; HC diets were more digestible and generated less fecal output, with YC enhancing this effect.

Key Words: Yeast culture, Forage:concentrate, *In vivo* digestibility

ADSA-SAD Undergraduate Competition - Dairy Production

188 The potential for use of sexed semen technology in the dairy industry. S. N. Van Exel*, *California Polytechnic State University*, *San Luis Obispo*.

Recent developments in flow cytometry have made sexed dairy cattle semen a potential tool for dairy producers. This technology makes possible a 90% probability of conceiving a heifer calf using sexed semen. What are the economics of this technology? Will sexed semen technology be accepted as an alternative to conventional artificial insemination in the dairy industry? Beneficial and potentially negative aspects of this technology will be discussed. What producers may likely benefit from the use of sexed semen in their reproductive programs? A profile of the potentially successful candidate for adoption of sexed semen will be discussed.

Key Words: Sexed Semen, Artificial Insemination, Reproduction

189 Management considerations for automated milking systems. S. J. Miller*, *The Pennsylvania State University*, *University Park*.

As labor costs increase and technology advances, more producers will find automated milking systems (AMS) to be a viable option. However, there are management considerations when switching from a conventional milking system to an AMS. Van de Vorst and de Koning (2002) showed that the introduction of robotic milking systems caused an increased milk SCC. Gygax et al. (2006) indicated that cows milked using AMS exhibited elevated cortisol secretion which may be linked to these higher SCC levels. Canadian producers reported between a 0% and 3.2% cull rate due to the switch to robotics. Culled cows had very close teat placement, rear teats that touched, or raised rear udders that made teats hard to detect in a horizontal plane. Genetic selection should be placed on these traits to avoid future culls. The biggest challenge will be to decrease the percentage of involuntary milkings. Involuntary milkings occur when cows do not enter the milking station in a specified period of time and producers must bring the cows to the system. Rodenburg and Wheeler (2002) found that it takes 3 to 4 weeks to reach an 80% voluntary milking rate. After the transition to an AMS, the study showed that an average of 12.6% of milkings were involuntary. Almost half of the involuntary milkings were due to lazy milkings, where cows with no signs of physical distress did not go to the milking station. Lazy milking fetch rates can be reduced by feeding small amounts of concentrate in the AMS to entice cows to be milked. The same study showed that by switching the concentrate from low energy (1.56 Mcal/kg) to high energy (1.96 Mcal/kg), voluntary visits per day increased from 3.40 to 4.04 and voluntary milkings per day increased from 1.72 to 2.06. Milk from AMS will have to comply with the Pasteurized Milk Ordinance in the U.S. The PMO has been revised to specifically address issues related to AMS. As labor becomes more of a challenge and producers become more aware of the management adaptations necessary to make a smooth transition, AMS will become more commonplace in the dairy industry as long as they are approved to meet legal milk standards according to the PMO.

Key Words: Automatic Milking System, Robotic Milking

190 The sale and consumption of raw milk. T. Webb* and D. Winston, *Virginia Polytechnic Institute and State University*, *Blacksburg*.

Niche marketing of dairy products including organic and raw milk sales are growing. Historically, raw milk has been consumed by producers themselves. Recently, the sale of raw milk has received great attention. Some consumers prefer raw milk over pasteurized milk because they believe it is more natural, is healthier and tastes better. Producers prefer it because of its convenience. Others claim that it is part of their culture to consume raw milk and milk products. The level of cheese illegally produced from raw milk in California is equivalent to four percent of all cheese produced in the state each year, much of it attributed to the culture in the area. Raw milk contains many pathogens, such as *Salmonella, Campylobacter jejuni, Escherichia coli* and *Listeria monocytogenes* that can cause severe health issues when consumed by humans. Nearly 76 million people are affected by food borne illness and 5000 people die each year, costing society nearly $20 billion. On average 250 of these deaths are from raw milk consumption, which tarnishes the image of the dairy industry. Twenty-eight states have banned the sale of raw milk to prevent such illness. Some consumers are circumventing these regulations through cow share and lease programs. Educational programs should be developed to educate dairy producers, consumers and decision makers about the health risks associated with the consumption of raw dairy products. Pasteurization has been shown to reduce microbial content in milk. The level of inactivation depends upon the temperature and time at which the milk is pasteurized.

Key Words: Raw Milk, Pasteurization

191 Breeding strategies for today's commercial dairy producers. M. M. Welper*, *Iowa State University*, *Ames*.

Implementation of crossbreeding programs is becoming increasingly popular as many commercial dairy producers try to take advantage of heterosis, or hybrid vigor. Heterosis describes the desirable outlying traits of a crossbred individual that are obtained by combining the diverse traits of its purebred parents. In today's dairy industry, many outstanding sires are readily available through AI to almost every producer across the globe, but these sires come from relatively few genetically distinct lines. Producers often utilize only bulls ranking in

the top percentiles over several generations to focus on the desirable traits that they are selecting for in their herd. Unfortunately, most of the top ranking bulls available in AI are even more or very closely related to each other since the top ranking bulls of one generation sire most of the next generation of bulls sampled in AI programs. Consequently, herds utilizing only top-ranking AI sires become increasingly inbred with each passing generation. Many producers are beginning to realize the drawbacks caused by inbreeding depression. This occurs when the genetics in a line of cattle becomes so focused that not only the desirable traits become more emergent but so do the non-desirable recessive traits. This often is expressed as negative consequences on performance parameters such as health, fertility, and longevity. Implementing crossbreeding into a dairy herd, ensures the prevention of inbreeding depression, and also incorporates into the herd traits from outside the current breed. Producers need to develop a crossbreeding strategy which maximizes heterosis, is easy to implement, and allows for long-term success.

Key Words: Heterosis, Crossbreeding

192 Waste milk vs. milk replacer. J. Downing* and C. C. Williams, *Louisiana State University*, *Baton Rouge*.

Two methods of raising dairy calves include feeding waste milk and feeding milk replacer. Waste milk is non-saleable milk such as excess colostrum, transition milk, mastitic milk, or antibiotic treated milk. Milk replacer is a powder which is mixed with water and resembles milk. Some of the common ingredients of milk replacer include whey, whey protein concentrate, animal and vegetable fats, vitamins, minerals and amino acids. Both practices have recommendations and guidelines to follow once a method of feeding has been selected. Disadvantages of feeding waste milk include microbial infections, antibiotic residues and resistance, higher calf mortality and increased veterinary costs. The most common microorganisms found in waste milk are *Streptococcus*, *Enterobacter*, *E coli, Listeria*, *Salmonella*, Bovine Viral Diarrhea, and Bovine Leukosis Virus. Organisms responsible for mastitis and Johne's disease can also be found in waste milk. If waste milk is going to be fed, pasteurization is a good idea. Pasteurization of waste milk can reduce the microbial load, decrease mortality and vet costs, and increase body weight gain of calves, but it does not remove antibiotic residues from the milk. There are guidelines for feeding waste milk which can help prevent disease causing microorganisms from being spread to calves. If milk replacer is fed, its nutritional quality should be evaluated before using. Milk replacers should contain a minimum of 20% protein and 15% fat. Vegetable oils should not be used in the milk replacer because they are poorly utilized by calves. Advantages of feeding milk replacer include disease prevention, convenience, increased performance, and economics. Beneficial additives can also be incorporated into the milk replacer which aid in growth and preventing calf-scours. Many farmers consider waste milk to be cheaper than milk replacer, but this is not the case when looking at opportunity cost. Waste milk can be a good source of nutrition for calves but negative factors such as antibiotic residues and infectious pathogens may impact your calves' health and decrease performance. Management practices are key factors in deciding which method is best in raising dairy calves.

Key Words: Calves, Waste Milk, Milk Replacer

Dairy Foods: The Dairy Management Inc. National Dairy Foods Research Center Program: Responding to Industry Needs for New Technologies, Products and Markets

193 The Dairy Management Inc.™ National Dairy Foods Research Center Program: responding to industry needs for new and improved technologies, products and ingredients. J. K. Kondo*, *Dairy Management, Inc.*, *Omaha, NE*.

Successful dairy and dairy-based product innovations rely on research. While customer and market insights fuel the product concepting process, the latest science and technologies can transform those concepts from ideas into successful products and ingredients. Through its Product Innovation Program, Dairy Management Inc.™ (DMI) provides industry with leading-edge dairy product and ingredient research and technical resources. The National Dairy Foods Research Center Program, a unified coordinated national research program conducted through six research centers, three applications labs and other universities, helps industry innovate to address unmet consumer demand for dairy and dairy-based products by providing the science for innovation as well as the knowledge to address product challenges. Presentations by center directors and scientists, representing each research center, will review current research under way in their facilities. The research covers technologies and processing methods for extended shelf-life products, high-value whey ingredients and co-product utilization, cheese with improved functionality and performance, and ingredients with enhanced functionality and performance.

Key Words: National Dairy Foods Research Centers, Dairy Centers, Dairy Research

194 Manufacture and application of casein concentrates. L. E. Metzger*, *South Dakota State University*, *Brookings*.

Milk protein concentrate (MPC) is extensively used as an ingredient in process cheese product formulations. In MPC approximately 20% of the total protein is whey protein and 80% is casein. In process cheese product applications casein provides a desirable firm un-melted texture and stringy, elastic melted texture, whereas whey protein forms a thermo-irreversible gel and produces a process cheese product that has restricted melt characteristics. Consequently the casein portion of milk protein is more valuable for use in process cheese product applications as compared to whey protein. The objective of this research was to develop a microfiltration process utilizing spiral wound membranes that is capable of producing a casein enriched protein concentrate (CEPC). Subsequently the performance of CEPC in process cheese product formulations was compared to conventional MCP. Three replicates of skim milk were processed into MPC using ultra/diafiltration and CEPC using micro/diafiltration. The mean total protein, casein, whey protein, ash, and lactose of the MPC and CEPC respectively were 74.3, 60.4, 13.1, 7.60, 11.9% and 73.2, 65.6, 6.6, 7.8, 6.1%. The MPC and CEPC were then utilized in process cheese product formulations. The process cheese product formulations were standardized to contain 15 and 25% MPC or CEPC (corrected to 75% protein). Each formulation was processed at 80 and 95°C. The process cheese products produced using CEPC had a significantly ($P<.05$) higher apparent

viscosity after manufacture and TPA-hardness as compared to those produced with from MPC. These results indicate that CEPC will have added value as compared to conventional MPC when used as an ingredient in process cheese product applications.

Key Words: Casein Concentrate, Microfiltration, Process Cheese Product

195 Creating new dairy ingredients uses – getting beyond the dairy case. P. S. Tong*, *California Polytechnic State University*, *San Luis Obispo*.

A large portion of dairy ingredients have been historically utilized in the manufacture of dairy foods. In such applications the dairy ingredients were utilized because they provided the desired sensory profile, nutrient composition and/or functional ingredient performance in a convenient and/or economical fashion. These dairy ingredient attributes continue to be important for their use in many food systems. However, as the food industry grows increasingly sophisticated in response to consumer expectations and the competitive market environment, getting beyond the dairy case will be a growing market opportunity and it will require recognition that more specific or customized ingredient solutions and associated service/support may be needed. One successful approach has been to maximize the functionality per unit of the dairy ingredient to provide the necessary economic advantage to the end-user. This has been an effective way to compete against other potentially lower cost, highly functional food ingredients. Dairy center research and applications programs have helped to characterize and optimize dairy ingredient functionality that has been one key foundation of the strong demand for dairy ingredients around the world today. However, increasing scientific evidence on the beneficial health effects of dairy protein consumption and other dairy components are creating new avenues to get us beyond the dairy case. Looking at how the other popular food ingredients are positioned and utilized in the food industry may shed some valuable insight on how dairy ingredients can get beyond the dairy case and how the national dairy centers and applications programs can help play a vital role.

Key Words: Dairy Ingredients, Dairy Protein, Food Applications

196 Defining the flavor of dairy products. M. A. Drake*, *North Carolina State University*, *Raleigh*.

Flavor plays a crucial role in customer and consumer purchase decisions. Trends come and go in the food industry but a desirable and consistent flavor is always required for market success. Defined sensory languages to describe flavor are fundamental tools which can serve as platforms to document flavor and to understand flavor chemistry and consumer perception. Sensory languages to document flavor characteristics were applied to cheese, dried dairy ingredients, butter, and fluid dairy products. Collected flavor information was used to document flavor variability and stability, to identify chemical sources of flavors and understand flavor carry-through in ingredient applications, and to construct consumer preference maps. Specific examples with cheese, dried dairy ingredients, butter, and fluid dairy products will be addressed.

Key Words: Flavor, Dairy Foods, Sensory Analysis

197 Improving the quality of low fat cheese. D. J. McMahon*, *Western Dairy Center, Nutrition & Food Sciences Department, Utah State University*, *Logan, UT*.

With the renewed interest in low fat foods, a DMI-funded collaborative project was undertaken to systematically study the differences between full fat and low fat cheddar cheese, with the aim of providing a basis for improving the flavor and texture of low fat cheeses. A method that included pre-acidification of milk to pH 6.25 and washing curd with cold water was developed to make a low fat cheese with 52 to 54% moisture and pH 5.15 to 5.25. A 50%-reduced fat cheese and a full fat Cheddar cheese were made without preacidification but with curd washing. A full fat Cheddar cheese without curd washing was also made. These cheeses were aged at 8 C and tested at 2 wk, 3 and 6 mo of aging. This presentation will present findings from analysis of these cheeses comprising sensory flavor, flavor chemistry, rheology, sensory texture, melting, bacterial microflora, and cheese biochemistry.

Key Words: Low Fat Cheese, Flavor, Texture

198 Process techniques to enhance the utilization of whey ingredients. J. A. Lucey*[1], S. Damodaran[1], and K. Smith[2], [1]*University of Wisconsin*, *Madison*, [2]*Wisconsin Center for Dairy Research*, *Madison*.

Various types of whey ingredients, including sweet whey, whey protein concentrates (WPC) and whey protein isolates (WPI), are popular food ingredients due to their excellent functional and nutritional properties. Some of the key developments over the past 20 years have included increasing purification of the protein fraction and the isolation of individual fractions. Membrane filtration techniques, such as microfiltration (MF), ultrafiltration and diafiltration, are now used for the production of WPI and polymeric spiral-wound MF membranes are also becoming popular. Currently, research is being conducted to enhance the functionality of whey powders so that they can be successfully used in applications such as nutritional bars, crispy snacks, and beverages. New processing approaches to enhance the functionality of whey ingredients include methods to reduce the residual lipids in WPC, exploring process conditions to alter the interactions between whey proteins and polysaccharides, crosslinking of whey proteins, incorporation of other proteins fractions with WPC, and the use of MF to fractionate caseins from whey prior to cheesemaking. These novel processing techniques could improve the clarity, flavor stability, heat stability, emulsification and foaming properties of whey ingredients. The goal of these research topics is to extend the functional range for existing whey ingredients into more challenging environments, e.g. clear, low pH beverages that have a high protein content and are also heat stable. Another key goal is to reduce the variability in functional performance (e.g. flavor, clarity, color) that can be observed in whey ingredients.

Key Words: Whey Ingredients, Functionality, Membrane Filtration

199 Breaking the 21 to 28 day shelf-life barrier on refrigerated HTST pasteurized milk. D. M. Barbano* and K. J. Boor, *Cornell University, Northeast Dairy Foods Research Center, Department of Food Science*, *Ithaca, NY*.

While ultra-high temperature (UHT) non-refrigerated shelf-stable milk has a long shelf-life, the U.S. consumer has not accepted the

sensory quality of this product. The refrigerated shelf-life of HTST pasteurized fluid milk has increased over the last 20 years as improved post-pasteurization milk handling and packaging systems have decreased post-pasteurization contamination. Improvements in raw milk quality have also contributed to increased shelf-life and flavor quality. Enclosed fillers with filtered air environments have allowed the best fluid milk processors to achieve 21 to 28 days of shelf-life. The organisms that typically spoil HTST milk after 17 d are pychrotolerant *Bacillus* spp. and closely related genera. These spores are present at low levels in high quality raw milk supplies, they survive HTST processing, and then grow rapidly after 17 d of refrigerated storage. In the last two years, fluid milk processors have increased HTST temperatures to improve the safety of fluid milk but this has stimulated outgrowth of spore formers and in some cases decreased shelf-life of HTST fluid milk. Alternative approaches, using removal of bacteria and spores are being explored in combination with HTST at minimum temperature and time, are being developed that will allow processors to break the 28 d shelf-life barrier.

Key Words: Fluid Milk, Shelf-Life, HTST

ADSA Southern Branch Symposium: Keeping Dairy Going and Growing

200 Structural shifts in the dairy industry. G. A. Benson*, *North Carolina State University*, *Raleigh*.

Dairy farm and cow numbers are declining, milk per cow is trending up, and milk production is increasing in the West and is flat or decreasing elsewhere. Understanding the factors causing these shifts can lead to more informed business decisions by farmers and allied industries, and is useful to policy makers. Causes include changes in product demand, technology, input availability and cost, and profitability. Government policies affect the general business climate, transportation costs, trade, and agricultural programs. There is little published work that quantifies the relative importance of each one for the dairy industry. Increased specialization has occurred to take advantage of economies of scale and size and capital has been substituted for labor. Technology has created increases in farm level productivity, both per cow and per acre. Trade and dairy policies create US prices that are above world prices and shield US producers from international competition. Productivity gains have outstripped the growth in sales, creating pressure on farm prices and reductions in cow numbers. The combined effect is the observed reductions in the size of the national dairy herd and farm numbers. Consumers are the primary beneficiaries, in the form of lower prices for dairy products. Regional changes are driven by differences in financial performance. Differences in input availability and cost affect production costs. Regional price differences are the result of local supply and demand conditions, transportation costs and, to some extent, federal and state milk pricing rules. Structural change also has occurred at the dairy cooperative, processor and retailer level. In general, the main changes have been a reduction in the number of business entities, increasing size, and greater concentration. Dairy farmers can only react to structural change as they make business plans but policy makers, new technology developers (including research and extension) can influence the direction and speed of change. Specific activities include changing the relative prices of milk in the various regions and initiatives that target specific regional rather than national issues.

Key Words: Structural change, Dairy

201 Problems associated with a dairy expansion effort. J. F. Keown*, *University of Nebraska*, *Lincoln*.

Over the years, many states have initiated projects to expand their dairy operations as a way to increase economic activity, increase employment, utilize the by-products generated by the expanding ethanol industry and revitalize rural portions of their states. To be successful, these activities take a concerted effort from all groups within the state, the Governor's Office, State Legislature, Department of Agriculture, as well as aligned dairy industries. In Nebraska, an effort to get local dairies to expand was not really successful until an effort was made to attract dairies from other parts of the country. The advertisements and promotional brochures produced discussing the Nebraska Advantage showed local producers the benefits that their own state offered the industry. Having other producers visit and discuss the opportunities that were available within the state helped local producers take a second look at the resources available to them for local and regional expansion. There are many obstacles to overcome when attempting to attract producers from other states such as climate, infrastructure, Department of Environmental Regulations for obtaining permits for easements and manure disposal, feed resources and costs, availability of multiple milk markets and local acceptance of large animal operations are all major concerns that must be considered. All of these obstacles have been encountered when working on the Nebraska effort and are common to all areas that are attempting to attract animal operations to their state. Many of these concerns cannot be addressed on a statewide basis but must be addressed individually, as each project is unique. The ability to address these issues and have all elements working in unison will result in successful or unsuccessful expansion efforts.

Key Words: Economic, Ethanol, Expansion

202 Adopting a management focus. R. A. Milligan*[1,2], [1]*Dairy Strategies, LLC.*, *St. Paul, MN*, [2]*Cornell University*, *Ithaca, NY*.

Every business needs a workforce with at least one person filling three roles as workers, managers, leader/chief executive. Over the last several decades an increasing number of dairy farms have develop expertise in the manager role. The challenge to keep the dairy industry going and growing is for each business to develop the expertise to successfully execute the chief executive role. The chief executive (CE) role is very different from the worker and manager roles. The CE is focused on strategy and people. The CE must have a greater external focus to understand what is happening in the global business environment including the quality movement, the markets for the business product, labor markets, and public policies impacting their industry. This information must then be utilized to develop and implement strategies to enable the business to thrive in our ever changing business environment. The chief executive must then assemble, inspire and develop a winning workforce team including:

1. Articulating the dairy businesses inspirational mission/vision/compelling vision.

2. Establishing a culture of quality, high expectations and continuous improvement.

3. Developing the organizational structure of the business.

4. Building the workforce team and developing and coaching leadership team members.

5. Seeking professional development opportunities to enable him or her to excel in this newer and less familiar role.

A great chief executive provides visionary leadership enabling the business (dairy business) to achieve extraordinary excellence over a long period of time. The owner can become a great chief executive for their business by making that role the number one priority. Unfortunately, few of us have the discipline to effectively operate as a CE, especially in a part-time role, without some structures to help. We need help maintaining focus on the important but not urgent tasks. Suggested vehicles to implement this priority include establishing a specific time for CE functions, structured meetings, engagement in activates to network with other CEs, professional improvement plans, and techniques for getting our good ideas on paper.

Key Words: Strategy, Leadership, Future

ADSA-SAD Undergraduate Competition - Dairy Foods

203 Dairy products shown to help reduce blood pressure. L. Gaver* and D. Winston, *Virginia Polytechnic Institute and State University*, *Blacksburg*.

Hypertension is a common disorder in which blood pressure remains abnormally high at a reading of 140 over 90 mm Hg or greater. It can be fatal if not detected and treated. Hypertension affects more than one in three American adults; 28% of adults age 18 and older have pre-hypertension. Statistics on hypertension caused the National Heart and Lung Association to begin the DASH Study, a multi-center, randomized clinical study that emphasized fruits, vegetables and fat-free or low-fat dairy products as the ideal diet for reducing blood pressure. The Dietary Approaches to Stop Hypertension Study was conducted in three phases: screening, run-in and intervention. DASH investigators concluded that a balanced diet rich in dairy products is a nutritional approach that can prevent and treat hypertension. They estimate that the DASH diet could reduce coronary heart disease by 15% and occurrence of stroke by 27%. Calcium and potassium are inversely linked to hypertension. Seventy to seventy-five percent of dietary calcium is from dairy products. The DASH diet reinforces the newly updated 2005 National Dietary Recommendations and is the basis for USDA's MyPyramid. The American Heart Association, as well as national guidelines for treatment of hypertension, support the conclusion that increasing dairy products in one's diet will help reduce blood pressure.

Key Words: DASH diet, Hypertension

204 Influence of low-fat dairy products on colorectal cancers. G. S. Christ*, *The Pennsylvania State University*, *University Park*.

Each year over 50,000 people die in the U.S. from colorectal cancer, the second leading cause of cancer deaths. The American Cancer Society estimates that in 2007 there will be 112,340 newly diagnosed cases of colon cancer and 41,420 cases of rectal cancer. Most people receive their dietary calcium from milk and milk products. It is thought that calcium binds secondary bile acids and free fatty acids in the colon, which may reduce colonic cellular proliferation. Alvarez-Leon et al. (2006) cited an inverse relationship between the intake of dairy products and colorectal cancer. Slattery et al. (2004) showed that increasing daily calcium intake up to 1200 mg from low-fat dairy products reduced the proliferation of colonic epithelial cells and returned them to normal differentiation. Holt et al. (2001) placed 40 people, all with initial signs of colorectal cancer, on one of two high calcium diets. Both diets were shown to reduce colonic epithelial cell proliferation. Kampman et al. (2000) concluded consumption of low-fat dairy products was associated with a significant decreased risk of colon cancer in men and women. These findings support an inverse relationship between high calcium consumption and colorectal cancer incidence. As a result of these studies and others highlighting the important role of dairy products in human nutrition and health, the USDA/HHS Dietary Guidelines for Americans 2005 increased the recommended servings of milk/dairy products from 2 to 3 servings per day.

Key Words: Calcium, Low-Fat, Colorectal Cancer

205 Role of dairy products in combating childhood obesity. J. A. Tekippe*, *Iowa State University*, *Ames*.

Childhood obesity continues as a growing health problem in the United States. Currently, 25% of children ages 8 to 19 in the US are overweight and 11% are obese. Several factors, including limited amounts of exercise or activity and the size of fast food portions, have been identified as contributing to this heath concern. Obese youth are at greater risk of developing type 2 diabetes, asthma, and hypertension prior to reaching adulthood. The diets of many American children contain an excess of calories but too little calcium. Over two thirds of American children are not receiving their calcium requirements. Minimum daily calcium requirement of children ranges from 800 mg during their early years to 1,300 mg during the teen years when most growth and bone building is taking place. Several controlled trials have been conducted to explore the relationship between weight loss and dairy products. Most concluded that overweight children consuming a reduced caloric diet that included recommended servings of dairy lost more weight then those who consumed little or no dairy products. The specific mechanism appears to support a role for calcium in weight loss. Specifically, consumption of a low calcium diet results in an increased production of calcitriol and promotes the entry of calcium into fat cells. The calcium in turn inhibits fat breakdown and promotes fat storage. Reducing the incidence of childhood obesity will require a two-pronged approach involving educational programs targeted at helping youth make healthy eating decisions, and motivating them to be more active or exercise regularly. Healthy eating decisions need to address portion sizes and their choice of foods, specifically those that are lower in calories and higher in needed nutrients such as calcium.

Key Words: Obesity, Weight Loss, Calcium

206 The significance of phospholipids and their emerging importance in dairy foods. R. L. Clarke*, *California Polytechnic State University*, *San Luis Obispo*.

Phospholipids are an important biological molecule in milk and milk components. Although minor in quantity comparatively (0.2-1 percent), phospholipids are important in milk fat and widely distributed as components of body cells. They are composed of fatty acids, phosphorous, and contain groups such as lecithin, cephalin, and sphingomyelin. Phospholipids exist in complexes with proteins in milk. Cream, separated from milk, contains about 65% of the lipid bound phosphorous and because of the high degree of absorption of the phospholipids by the fat molecules there is additionally provided stability. Phospholipids are distributed throughout cell membranes, and are emerging as an area of active research in Dairy products. Because the molecule is made up of two distinct regions, one hydrophobic and the other hydrophilic, they react in water to spontaneously form a bilayer. As well as being biologically significant, this property holds great many areas of nutrition and medicine. Since milk is a good source of these phospholipids it is understandable that there is current research to be able to obtain and preserve them in dairy foods such as milk powder and other products.

Key Words: Phospholipids, Milk Powder

Bio Ethics - Livestock and Poultry: The Ethics of Food

207 The ethics of food. J. M. Regenstein*, *Cornell University*, *Ithaca, NY*.

Believe Nothing That You Think! We all like to think of ourselves as ethical, and think carefully about our ethical standards, yet we often do not agree with each other on what is right and wrong. Why? Because our ideas are formed not just through our scientific/rational training but also from inputs that are beyond our scientific/rationale education. Our ethical beliefs reflect who we are. But, as a society, the only way to approach ethics with a hope to reach agreement/compromise is to address ethical issues using rational arguments and reasoning. Therefore, ethical judgments must be offered in the "Marketplace of Ideas" and be able to withstand critical evaluation by those who may disagree. Formally, this is required within the field of philosophy: "Philosophy, like morality itself, is the first and last an exercise in reason, the ideas that should come out on top are the ones that have the best reasons on their sides." (Rachels, The Elements of Moral Philosophy, 1999. p. xii). So the challenge in participating in the debate is to use rational arguments when discussing controversial ethical principles? (And admit when one's arguments are emotional?) But what are rational arguments? This can be difficult to determine although irrational ones are probably easier to identify. An important irrational one centers around the following point: If something specific is wrong (rationally unacceptable? unethical?) with a particular system, i.e., such as a number of the concerns consumers have with the food system, especially animal agriculture; what does that mean? That we should analyze the specific problem, look for rationale solutions, and work hard to apply those solutions to correct that problem and then continue to evaluate how effective the solution is and continue to seek better solutions. What the problem does not rationally imply is that the system identified should not exist (e.g., eliminate animal agriculture) and/or that because of these problems, another system should replace it (e.g., veganism). The replacement needs to justify itself on its own rationale evaluation and merit. In the meantime, we need to work hard to find solutions to these critical problems.

Key Words: Animal Agriculture, Ethics, Food

208 The ethics of semantics: do we clarify or obfuscate reality to influence perceptions of food animal production? C. C. Croney*[1] and R. D. Reynnells[2], [1]*Oregon State University*, *Corvallis*, [2]*US Department of Agriculture, Cooperative State Research*, *Washington, DC*.

According to linguists, the discourse of animal production uses metaphors, pronouns, and definitions that consistently represent animals as objects, machines, and resources, instead of as distinct, unique individuals. Thus, it is argued, genuine concern for animal welfare is either obscured by financial concerns or circumvented entirely, which permits animals to be kept and treated in ways people would otherwise find objectionable. Substituting euphemisms like "crops," "units," and "harvest" for "herds," "animals," and "slaughter," which are more likely to evoke images of grape plucking than of killing animals for food, might indeed seem disingenuous, especially given the common industry refrain that the public needs to be better educated about food production. However, the implication that the animal industries deliberately employ such techniques is debatable. What is clear is that the semantic obfuscations rampant in the language of modern farm animal production reflect underlying ambivalence about full and frank public education about many standard industry practices. First, consumers are unlikely to want full disclosure of all aspects of animal production. Second, there is real risk that certain realities of animal production would be aversive to consumers, who might consequently refuse (as is their right) to purchase particular products, thus causing significant industry losses. Yet, the animal industries' reluctance to "come clean" in public education efforts raises another problem---that adopting innocuous terminology and withholding information deemed likely to be unpalatable to the public is morally questionable in itself. Moreover, this provides an avenue for opponents of animal agriculture to exploit. In truth, animal extremists are now in a position to reveal facts about livestock production that might not only disturb consumers, but also cause speculation about the industries' failure to be forthcoming. As a matter of professional ethics and viability, animal industry members should reconsider the discourse of farm animal production to ensure that what is conveyed is accurate and intended.

Key Words: Ethics, Semantics, Animal Production

209 What would the world be like without animals for food, fiber, and labor? Are we morally obligated to do without them? S. L. Davis*, *Oregon State University*, *Corvallis*.

Numerous animal rights theorists have concluded that nonhuman animals have moral standing and non-interference rights. Therefore, they say that humans are morally obligated to stop using animals for food, fiber, labor and research. I disagree with that conclusion for at

least two reasons. First because it has been demonstrated that food production models are possible using large herbivores that might actually cause less harm to animals than a vegan food production model. This is because intensive crop production used to produce food for a vegan diet kills (harms) far more animals of the field than extensive agriculture (pasture production). So, a combined food production system that includes crops, and pasture harvested by large herbivores to be used for human food may kill fewer animals than would a vegan/crop model. Second, I say no for pragmatic reasons. It is improbable that all peoples of the world could ever be convinced that they must give up animals. In fact it may be unethical to try to do that because in poor countries these animals are essential to the survival of the human populations. But what about the richer nations? Maybe they will/should be convinced to do without animals because of the moral strength of the animal rights theories. However, I believe that there are far too many obstacles for that to happen. What then are we morally obligated to do about animals? I suggest that animals do have moral standing and that we are morally obligated to recognize their unique species-specific natures, and treat them accordingly. That would mean treating animals according to their physical and behavioral needs or telos. That, I believe is the most likely outcome of the conversation about animal rights.

Key Words: Animal Rights, Welfare, Moral Obligations

210 Ethics and the role of academics, scientists and veterinarians in the formation of public attitudes and societal decisions. W. R. Stricklin*, *University of Maryland*, *College Park*.

Ethics has to do with "doing the right thing," but reaching a societal-wide consensus on the right thing to do is often difficult. For example in the USA, there is a wide range of opinions regarding the right thing to do about the use and treatment of food animals. On the one-hand, some persons within both academia and the public at large contend that it is wrong for humans to use other sentient beings as simply a means to an end, i.e., food. Further, they contend that eating animal-based food products should be phased out. On the other hand, some persons - including a significant number of animal scientists - contend that providing food for humans is a greater good that justifies the treatment of food animals across basically all current agricultural housing systems and production practices. And there is a middle position that includes the majority of persons who wish to continue to consume animal food products but also want assurance that the welfare of the animals is appropriately considered. In the USA, the viewpoint of the educated expert or authoritarian figurehead is still generally respected by the public. However, to maintain this credibility, the public must continue to feel that the information they are presented is unbiased. In some instances, animal scientists are becoming viewed as being too closely tied to industry viewpoints and not giving a balanced view of some issues, including animal welfare. Ultimately, both veterinarians and animal scientists have roles to play in helping the public at large gain a greater understanding of the importance of doing the right thing in terms of how animals are to be treated in our society. Thus, it is important that these professionals acknowledge the importance of ethics in their research, teaching, and other professional activities.

Key Words: Animal Welfare, Bioethics, Public Attitudes

211 Production, processing and marketing: an integrated industry's view of ethical issues. C. Klippen*, *Klippen & Associates, LLC*, *Audubon, PA*.

Decision making is a part of everyday living. In satisfying our basic needs, decisions are made about what to eat, what to wear, how to get where we are going, when to sleep. There is another type of decision that we also make that could be described as ethical. There's a purity about a decision labeled "ethical". What's the basis for that claim of its being "ethical". Whose values judgment underscore that ethical decision? In making a decision we try to balance an outcome that we perceive as morally right with what is practical and logical from our set of values. We may view the importance of the outcome as justifying the means in making that decision. Is that "ethical"? We may not know or understand all the facts, yet is it better to decide rather than be indecisive? So, we decide, basing our decision on competing moral perspectives. Evaluating complex and sometimes ambiguous scenarios adds to the dilemma in making a decision. When operating in a framework of proven principles that are reliable, our skills for decision-making are more self-assuring. We center on our beliefs about what we perceive to be right or wrong. Is this ethical? As it relates to producing animals for food, processing and marketing meat, milk or eggs, what proven principles aid the decision as to how that animal is raised, processed, or how the animal product is marketed? Is it efficiency in production, processing coupled with profitability in marketing that dictates the "ethical decision"? Or is it a practical decision that is expedient based on the current needs of society? Is there a reasoning approach from history that can help shape our ethical decisions?

Key Words: Marketing, Processing, Production

Breeding and Genetics - Livestock and Poultry: Beef Cattle

212 Identification and characterization of microRNA from the bovine adipose tissue and mammary gland. Z. Gu*, S. Eleswarapu, and H. Jiang, *Virginia Polytechnic Institute and State University*, *Blacksburg*.

MicroRNA (miRNA or miR) are a new class of small RNA molecules (~22 nucleotides) that are processed from precursor sequences that form hairpin secondary structures. miRNA inhibit translation or induce degradation of protein-coding mRNA by base-pairing. Increasing evidence suggests that these small RNA molecules play an important role in many processes of animal development and physiology. We have conducted a study to identify miRNA in cattle. By cloning and sequencing small RNA from the bovine adipose tissue and mammary gland and by predicting and folding the precursors of these small RNA sequences, we have identified 59 distinct bovine miRNA. Five of them were not homologous to any known mammalian miRNA, hence potentially novel miRNA. Twenty-five of them had 3' and (or) 5' end variants, suggesting that miRNA precursors may be alternatively processed. Ribonuclease protection assays (RPA) of 12 selected miRNA confirmed their expression in adipose tissue or the mammary gland, from which they were originally cloned. The RPA also indicated tissue-specific or tissue-enriched expression for several miRNA. For example, miR-122a was only detected in the liver, and miR-133 was detected in the heart, skeletal muscle and rumen but not in ten other

bovine tissues. These results demonstrate that miRNA are expressed and may play an important role in cattle too.

Key Words: microRNA, Cattle, Adipose

213 Feed efficiency of tropically adapted breed and breed cross steers when fed in the southern plains. S. W. Coleman*[1], W. A. Phillips[2], C. C. Chase, Jr.[1], and D. G. Riley[1], [1]*USDA ARS Subtropical Agricultural Research Station*, *Brooksville, FL*, [2]*USDA ARS Grazinglands Research Laboratory*, *El Reno, OK*.

Beef cows in the subtropical USA require that they be adapted to the stressors of the environment. However, calves produced in the region are usually grown and finished in more temperate regions. The objective of this paper is to determine the feed efficiency of steers from a 3-breed diallel mating of Angus (A), Brahman (B) and tropically adapted Romosinuano (R), a Criollo breed native to Colombia. Calves (n = 261) born over 3 yr from 2002-04 were straightbred AA, BB and RR, or crossbreds (RB, BR, RA, AR, BA, AB; letters indicate breed of sire and dam, respectively). Steer calves were weaned in September and shipped 2025 km to El Reno, OK for growing and finishing. After grazing wheat pasture until May, 2003, they were finished on a conventional feedlot diet using Calan headgates to obtain individual feed intake. Steers were serially harvested at three times each year, ranging from 93 to 168 days on feed. Feed efficiency was calculated as feed per unit gain (FdGn) and as residual feed intake (RFI). The MIXED model included effects of year, stocker treatment, and replicate. Days on feed and calf age at the beginning of the feedlot phase were fit as continuous variables. Sire within breed was the random term. Significance is denoted by + ($P < 0.10$), * ($P < 0.05$) or ** ($P < 0.01$). Direct effects for initial and final weight and daily gain were 43**, 16, and -21+; 19+,61**, and 0.31**; and -62**, -77** and -.10 kg for A, B, and R, respectively. Direct effects for daily DM intake, FdGn, and RFI were -1, 2.16*, and 0.48+; -.25, -2.73**, and -.44+; and 1.25+, 0.57, and -.05 for A, B, and R steers. Heterosis ($P < 0.01$) was noted for all breed combinations for initial and final weights, but not for rate of gain. There was negative heterosis ($P < 0.01$) for intake by A-B and for B-R crosses. There was no heterosis for feed efficiency. In conclusion, Brahman influenced steers appear to be more efficient than Angus and Romosinuano was intermediate.

Key Words: Feed efficiency, Brahman, Romosinuano

214 Genetic evaluation of growth in a multibreed beef cattle population using random regression linear spline models. J. P. Sanchez*[1,2], I. Misztal[1], I. Aguilar[1], and J. K. Bertrand[1], [1]*University of Georgia*, *Athens*, [2]*University of Leon*, *Leon, Spain*.

The objective of this study was to examine the feasibility of using random regression, spline models (RR-s) for fitting growth traits in a multibreed beef cattle population. The evaluation results from this model were compared to those obtained using a multi-trait model (MT) when both were used to fit the US Gelbvieh data set (1.8 million records and 1.1 million animals). Both models included direct and maternal additive genetic, contemporary group, age of the animal, direct and maternal heterosis, and direct and maternal additive genetic mean of the breed effects. Additionally, the RR-s model included a direct permanent environmental effect. The effect of prior information for heterosis and breed effects on the EBV of sires was also investigated. When both MT and RR-s models were fitted to the data set containing records for weaning weight (WWT) and yearling weight (YWT) within specified age ranges and medium weight was posed on prior information, the rankings of bulls direct EBV (as measured via Pearson correlations) provided by both models were comparable (≥ .99). For maternal effects, these correlations were also high, being the lower case YWT (= .92). The inclusion of prior information had negligible effect in the overall ranking for bulls with greater than 20 BWT progeny records, the correlations between EBV obtained in the situations of weak and strong prior information were ≥ .98 for direct effect and ≥ .87 for maternal effects. However, the effect of prior information for breeds or groups poorly represented in the data, i.e. Zebu, was very important. By using the random regression approach, to discard records outside the usual age ranges of measurement can be avoided and higher accuracies are achieved (2.5% WWT and 2.9% YWT). However the overall rankings after adding this extra information remains nearly unchanged, correlations between them were ≥ .96(≥ .95) for direct effects (maternal effects). RR-s model requested three times more rounds to convergence (5.0e-13) than the MT model.

Key Words: Beef Cattle, Growth, Linear Splines

215 Growth and carcass characteristics of lot-fed Wagyu beef cattle and the estimation of homozygosity from band sharing patterns of random amplified polymorphic DNA markers. A. E. O. Malau-Aduli*[1], S. Inoue[2], T. Richards[2], A. Howard[2], and A. Thompson[2], [1]*University of Tasmania*, *Hobart, Tasmania, Australia*, [2]*Tasmania Feedlot Pty Ltd*, *Perth, TAS, Australia.*

The Wagyu breed of beef cattle is renowned for its ability to deposit high levels of intramuscular fat resulting in highly marbled beef that meets consumer demands in some niche export markets. We evaluated the post-weaning growth performance and carcass characteristics at slaughter of purebred Wagyu steers raised in the feedlot after an initial backgrounding on grass and silage. Our main aim was to study the average daily gains (ADG), body condition scores (BCS) and liveweight (LWT) changes from weaning to slaughter and to estimate homozygosity and inbreeding coefficients through band sharing patterns using random amplified polymorphic DNA (RAPD) markers. LWT, ADG and BCS were monitored monthly from 2005-2006. Genomic DNA was extracted from blood samples, amplified using RAPD primers, fragments resolved by gel electrophoresis and banding patterns elucidated under UV light. A linear increase in liveweight as age increased was observed and the typical fluctuation due to seasonal variations observed under grazing conditions was unnoticeable. Average LWT ranged from an initial 110kg to 660kg, ADG ranged from 0.7–2.0kg/day and BCS reached the maximum of 5 at the end of the experiment. Average LWT at slaughter was 574kg with a hot carcass weight of 329kg and a dressing percentage of 57%. Mean eye muscle area was 94cm2, eye muscle width 8cm and eye muscle length 16cm. Marbling score was 3, subcutaneous fat depth of 17cm and total trimmed fat weight was 34kg. Average saleable meat yield based on the 4 most valuable hind muscles were: Round (11.7kg), Topside (19.3kg), Rump (13.6kg) and Silverside (15.8kg). Average band sharing frequencies ranged from 0.60 to 0.96 with estimated inbreeding coefficients ranging from 0.5% to 7%, respectively. It was concluded that the inbreeding level was low, negligible and not in any way detrimental to meat yield and carcass quality destined for the Japanese market. Finally, RAPD markers were not versatile enough to

clearly differentiate between the fastest and slowest growing animals within the Wagyu breed.

Key Words: RAPD Markers, Wagyu, Carcass Traits

216 Examination of residual feed intake with post-weaning growth and carcass traits in central test bulls. G. S. Hecht* and L. A. Kriese-Anderson, *Auburn University*, *Auburn, AL*.

Since 1978, individual feed intake has been measured on bulls (n = 2,180) consigned to the Auburn University Bull Test along with weights, heights, scrotal circumference and ultrasound carcass traits. Test length since 1977 was reduced from 140 d to 112 d to 84 d. Eight breeds were used in MTDFREML analyses to estimate heritabilities of and genetic correlations between residual feed intake (RFI) and average daily gain (ADG), scrotal circumference (SC), 12th rib fat thickness (FT), *longissimus dorsi* area (REA) and percent intramuscular fat (IMF). Breeds included were Angus (n = 857), Brangus (n = 41), Charolais (n = 380), Gelbvieh (n = 103), Hereford (n = 192), Limousin (n = 106), Santa Gertrudis (n = 106) and Simmental (n = 395). Traits were analyzed using three trait analyses and a sire-maternal grandsire model with either age or weight as covariates. Fixed effects included length of test, breed and year. Covariance estimates were averaged across analyses. Estimates of genetic correlations between RFI and ADG, SC, FT, REA, IMF and FE were 0.00, -0.03, -0.03, -0.44, 0.62, and 0.51, respectively with age as covariate. Estimates of genetic correlations between RFI and ADG, SC, FT, REA, IMF and FE were 0.12, 0.19, -0.02, -0.70, 0.64, and 0.44, respectively with weight as covariate. Heritability and genetic correlation estimates of all traits were on the lower end of reported literature estimates. These results may be due to consignment of elite bulls to a central test station and suggest that selection of animals with a lower residual feed intake should not increase individual size and should improve feed efficiency.

Table 1. Means and Heritability Estimates of Traits Across Breeds

Covariate	RFI	ADG	SC	FT	REA	IMF	FE
Age	0.08	0.17	0.14	0.17	0.07	0.16	0.12
Weight	0.09	0.16	0.17	0.15	0.12	0.12	0.12
Means	1.04 kg/d	1.73 kg/d	36.32 cm	0.80 cm	100 sq cm	3.20 %	3.42 kg/d

Key Words: Residual Feed Intake, Bulls, Post-Weaning Growth and Carcass

217 Genotype by environment interactions estimated by using reaction norms in Brazilian Nellore cattle. E. A. Maricle*[1], J. C. Souza[2,3], L. O. Campos de Silva[3], A. Gondo[3], R. L. Weaber[1], and W. R. Lamberson[1], [1]*University of Missouri*, *Columbia*, [2]*Parana Federal Univeristy*, *Palotina, PR, Brazil*, [3]*Embrapa*, *Campo Grande, MS, Brazil*.

The influence of genotype by environment interactions (GxE) on animal performance complicates selection decisions. Reaction norms are a statistical technique used to characterize GxE. The objective of this study was to evaluate GxE by comparing reaction norms among Brazilian Nellore bulls. Dependent variables were birth, 205 d weaning, 365 d yearling, and 540 d weights. Weights were adjusted for known fixed effects based on Beef Improvement Federation Guidelines. Environments were defined as progeny groups with a common herd, birth year and season (wet or dry). For data to be included, the following criteria had to be met: all four weights had to be recorded on each progeny, a minimum of four progeny were present in each environment, progeny were present in five different environments, and each environment contained three bulls (n = 4,280 progeny, n = 57 bulls, and n = 161 environments). Reaction norms for each bull were calculated by regressing progeny means within an environment, weighted by number of progeny, on environment means (SAS PROC GLM). To create pseudoreplication, bulls with progeny in ten or more environments had separate regressions determined for each set of five environments. Regression coefficients were fitted to an ANOVA model including bull and environment. Regression coefficients differed among bulls for all traits ($P < 0.0001$). Proportion of variation accounted for by bull and environment, respectively, were for birth weight 0.05 and 0.58; for weaning weight 0.08 and 0.43; for yearling weight 0.08 and 0.49; and for 540 d weight 0.07 and 0.44. These results suggest that bulls differ in the consistency of their progeny's performance across environments. Estimates of genetic merit of regressions from reaction norms may be a useful selection tool for ranking bulls to be used across diverse environments.

Key Words: Beef Cattle, Genotype x Environment Interaction, Reaction Norm

218 Genetic parameter estimates for two measures of disposition. F. E. Creason* and R. L. Weaber, *University of Missouri*, *Columbia*.

Two measures of disposition were collected on Angus and Red Angus cross steers (n=315) with known pedigree from four sources during the initial weighing of steers on a feedlot trial. Steers were weighed and disposition scores recorded through two facilities on the same farm. Disposition was measured as pen score (PS; 1=gentle, 5=aggressive) and exit velocity (EV; m/sec). Exit velocity was measured using infrared electronic triggers to start and stop an electronic recording device to time a steer as it traveled a fixed distance upon exiting a squeeze chute. Exit velocities were recorded when animals were weighed on two consecutive days. The weights and EV were averaged to produce AVGWT and AVGEV. Pen scores were recorded during the feeding trial. At the start of the trial steers in each facility weighed 342.6 ± 25.3 kg and 305.4 ± 32.0 kg, EV averaged 2.50 ± 0.68 m/sec and 2.68 ± 0.99, while PS averaged 1.95 ± 0.70 and 1.86 ± 0.81 respectively. Previous work has shown that EV and PS are positively correlated. EV and PS are negatively correlated with weight gain during the 55d post-weaning growing period and with feedlot placement weights. Sire was included in these models as a random effect and found to be a significant source of variation suggesting a heritable component of disposition. The data described above was included in a sire genetic model to estimate (co)variance components and heritabilities for EV and PS. A two-trait model was fit that included contemporary group (source, collection location, GrowSAFE group) as a fixed effect. Linear and quadratic covariates for each trait included age (d) and AVGWT. A six generation sequential pedigree of 661 animals including 315 progeny and 26 sires was generated. Genetic parameters and expected progeny differences (EPD) were calculated using MTDFREML software. Estimates of heritability (standard error) for EV and PS were 0.35 (0.078) and 0.15 (0.058) with a genetic correlation of 0.28 (0.825). Average, min. and max. EPD for EV and PS were -0.02, -0.33, 0.27 and 0.01, -0.10, 0.10, respectively.

Key Words: Temperament, Heritability, Genetic Parameters

219 Segregation of polymorphisms at Calpain and Calpastatin in beef cattle grown in the tropics. J. H. Bosques-Méndez*[1], M. Pagan[1], and E. Casas[2], [1]*University of Puerto Rico*, *Mayagüez, Puerto Rico*, [2]*Roman L. Hruska USDA MARC*, *Clay Center, Nebraska*.

The distribution of single nucleotide polymorphisms (SNP) in two regions of Calpain (CAPN1-316 and CAPN1-530) and a SNP in Calpastatin (CAST) was determined in beef cattle grown in the tropics (n = 372). Genotypic and allelic frequencies were determined for each SNP in Senepol (n=60), Charolais (n=62), Angus (n=39), Charbray (n=43), Brahman (n=19), Zebu (n=17) and crossbred bulls (n=132). For CAPN1-316, genotypic frequencies were 0.05/AA, 0.63/AG and 0.32/GG with allele frequencies of 0.21/A and 0.79/G. The AA genotype was absent in Charbray, Charolais, Angus, Zebu and Brahman breeds. In Charolais and Senepol GG was greater than AG and the inverse was observed for Zebu, Brahman and Crossbred bulls. In Angus bulls, the AG and GG genotypes were evenly distributed. The A allele was more frequent in Charolais, Angus, Zebu and Brahman, whereas the G allele predominated in Charbray and crossbred animals. Genotypic frequencies for the SNP in CAPN1-530 region were 0.17/CC, 0.40/CT and 0.43/TT. Allelic frequencies were 0.39/C and 0.61/T. Animals of CT genotype were more frequent in Charolais, Senepol, Angus and crossbred, whereas TT was more common in Charbray, Zebu and Brahman bulls. Greater allelic frequencies for C were observed in Senepol and Brahman. The inverse was observed in the other breeds. For CAST, genotypic frequencies were 0.03/CC (n=10), 0.26/CT (n=79), and 0.71/TT (n=79), respectively. Global allele frequencies were 0.46/A and 0.54/C. The allelic frequency of C was greater in Charolais and Angus bulls. Animals having CC genotype were absent in Charolais, Angus and Brahman animals genotyped. The TT animals were more frequent in Charbray, Charolais, Senepol, Angus Brahman, Zebu and crossbred animals. The segregation of the polymorphisms in CAPN1 and CAST could be implicated in differences observed in economically important traits in beef cattle grown in tropical environments.

Key Words: CAPN1, CAST, SNP

220 Genetic analysis of rebreeding to produce a calf at three years of age in beef cows. J. M. Rumph*[1], D. D. Kress[1], K. C. Davis[1], D. C. Anderson[1,2], R. M. Enns[3], C. M. McAllister[1], and D. L. Boss[2], [1]*Montana State University*, *Bozeman*, [2]*Montana State University*, *Havre*, [3]*Colorado State University*, *Fort Collins*.

Rebreeding a first calf heifer to produce her second calf at 3 yr of age can be challenging for beef producers. Heifers generally require more recovery time following their first calf which may delay the onset of estrus to a point beyond the normal breeding season. In an effort to improve heifer rebreeding, data on beef cows at 2, 3, and 4 yr of age were analyzed to determine if rebreeding of first calf heifers is under any degree of genetic control. Records on 417 females born from 1976 – 1994 were analyzed to determine genetic parameters and the percentage of females in each breed group that produced a calf as a 3-yr-old after having their first calf as a 2-yr-old. Animals included in the analysis consisted of Hereford and Tarentaise purebred cows as well as F1, F2, and 3/4 blood females created from these two breeds. Young cows in this herd were not culled unless they were open for two consecutive years. To be included in the data set, cows were required to produce a calf as 4-yr-olds to avoid bias due to culling for reasons other than ability to breed back at 2 years of age. Overall, 72% of females were successful in breeding back to produce a calf at 3 yr of age. Individual groups were 73%, 79%, 64%, and 62% successful for purebreds, F1, F2, and 3/4 blood cows, respectively. To estimate the genetic parameters associated with this trait, data was analyzed using MTDFREML with breed type, heterosis percentage, and year of birth as fixed effects. Based on the observed trait, heritability was estimated to be 0.08. Converting the observed trait to the underlying scale produced a heritability for rebreeding of 0.14. Although this is a lowly heritable trait, there does appear to be a genetic component and selection against females who fail to rebreed should result in a positive genetic response.

Key Words: Genetic Parameters, Reproduction, Beef Cattle

221 Evaluation of the relationship between scrotal circumference and ultrasound intramuscular fat measurements in Angus cattle. A. M. Arnett*, J. M. Bormann, M. E. Dikeman, and D. W. Moser, *Kansas State University*, *Manhattan*.

Recently, cattle breeders have questioned whether scrotal circumference has an impact on ultrasound predictions of intramuscular fat (IMF). The objective of this study was to investigate the relationship between ultrasound intramuscular fat (IMF), carcass marbling score (MS), and yearling scrotal circumference (SC) in Angus cattle. The American Angus Association provided pedigrees and expected progeny differences (EPD) for 290 Angus sires. All sires in the dataset had an accuracy of at least 0.50 for IMF EPD and MS EPD. Accuracies ranged from 0.50 to 0.97 (mean 0.75) for IMF EPD, 0.50 to 0.89 (mean 0.62) for MS EPD, and 0.05 to 0.96 (mean 0.73) for SC EPD. Individual performance records from 332,162 progeny of these sires and their contemporaries were also provided. These data were age-adjusted to 365 d for growth and ultrasound traits, and to 480 d for carcass traits. Correlations of SC EPD with IMF EPD and MS EPD were not significant ($P > 0.10$). Correlations existed ($P < 0.05$) between SC EPD and birth weight EPD (0.12), weaning weight EPD (0.13), yearling weight EPD (0.14), yearling height EPD (0.25), mature height EPD (0.17) and ultrasound scan weight EPD (0.22). IMF EPD was regressed on Marbling score EPD alone and with SC EPD. Intramuscular fat EPD was highly significant ($P < 0.01$) in predicting MS EPD. Scrotal circumference EPD was also a significant ($P < 0.05$) predictor of MS EPD, but only explained an additional 1% of the variation. Linear and quadratic regressions of IMF on SC were estimated from the performance data. Regression coefficients for SC were small but significant (-0.086, linear and 0.001, quadratic; $P < 0.05$). Correlations of high-accuracy sire EPD indicate that selection for SC should not significantly influence carcass traits.

Key Words: Beef Cattle, Intramuscular Fat, Scrotal Circumference

222 Phenotypic relationships among measures of feed utilization, ADG, and ultrasonic measures. K. A. Gray*, G. B. Huntington, M. H. Poore, C. S. Whisnant, and J. P. Cassady, *North Carolina State University*, *Raleigh*.

The objective of this research is to estimate phenotypic relationships among measures of feed utilization and economically important traits in beef cattle. Data were available from 124 registered Angus bulls (262 ± 3.4 Kg BW, 266 ± 1.76 d of age) from the NC State University Historic Angus Herd which is maintained at the Upper Piedmont Research Station in Reidsville, NC. Bulls were blocked based on BW

and sire into groups of 12, adapted to a corn silage-based diet (140g CP, 1.73 Mcal NEm and 1.22 Mcal Neg per kg DM), and trained to use calen gates. Feed offered was recorded on a daily basis and used to calculate average daily feed intake. Bulls were weighed every 14 d and growth (ADG) was determined by linear regression of weight against time. Mean ADG and DMI were 1.52 ± .23 DM/day and 7.25 ± 1.12 kg. Three measures of feed utilization were calculated and compared. Feed to gain ratio (FGR) was calculated by taking the average DMI of each bull divided by ADG. Residual feed intake (RFI) was calculated using two different methods. Method 1 was based on the NRC equations (NRFI) and for method 2 phenotypic regression using ADG and DMI adjusted to a common 42 day mid weight (RRFI) was used. Partial correlations with sire nested within year, year, and pen as fixed effects were calculated. Correlations between NRFI with RRFI, FGR and ADG were 0.965, 0.794 and -0.217, respectfully. Correlations between RRFI with FGR and ADG were 0.819 and -0.005. There were no relationships found to be significant between feed utilization calculations and ultrasonic measurements of intramuscular fat, rib eye area, rump fat and rib fat. As expected NRFI and RRFI were highly correlated indicating that they are the same trait. Both NRFI and RRFI were highly correlated with FGR. It was concluded that FGR is a good predictor of RFI. Alternative methods of calculating RFI were found to be nearly identical and independent of ultrasonic measures of body composition.

Key Words: Beef Cattle, Residual Beef Intake, Efficiency

Breeding and Genetics - Livestock and Poultry: Dairy Cattle I

223 Dry matter feed intakes for first lactation Holstein, Jersey and their reciprocal crosses in the Virginia Polytechnic Institute and State University crossbreeding project. K. M. Olson*, B. G. Cassell, and M. D. Hanigan, *Virginia Polytechnic Institute and State University*, *Blacksburg*.

The crossbreeding project at Virginia Polytechnic Institute and State University began in the fall of 2002. Holstein and Jersey foundation females were mated to four Holstein bulls and four Jersey bulls to create JJ, HH, JH and HJ breed groups (sire breed listed first). Collection of individual feed intakes on first lactation project cows began in September 2005 and continues through 2007. Individual feed intakes are measured in two week trials during every six week period (two weeks on, four weeks off) on first lactation cows less than 305 days in milk. All cows were fed the herd total mixed ration before and during the trial. Forages, grains and concentrates were submitted for nutrient analyses at least once during each trial period. An 'as-fed' intake and dry matter intake were calculated daily for the project cows during the feed intake cycle and averaged across week of production. A mixed model using repeated records was used to analyze dry matter intakes. Effects included trial, breed group [(HH (n=25), HJ (n=17), JH (n=15), JJ (n=11)], age at calving, week in milk and breed by week in milk interaction. Significant effects ($P<0.05$) for dry matter intake included breed group and week in milk however, the interaction between week in milk and breed and differences between trials were not significant. LSM for dry matter intakes across all weeks were 22.2 ± 0.3, 21.2 ± 0.3, 20.8 ± 0.4, and 17.5 ± 0.4 kg for HH, HJ, JH and JJ respectively. In general, dry matter intake reached a plateau at 13 weeks. All breed groups were significantly different from one another except the HJ and JH. Visual inspection of breed group means by week in milk suggests a positive heterosis for dry matter intake (untested).

Key Words: Crossbreeding, Dry Matter Intake, Feed Intake

224 Comparison of Holstein–Friesian, Norwegian Red and Holstein–Friesian×Norwegian Red cows on Irish dairy farms: Milk production and udder health. N. Begley*[1,2], M. Rath[2], and F. Buckley[1], [1]*Teagasc*, *Moorepark, Fermoy, Co. Cork, Ireland*, [2]*School of Life Sciences*, *UCD, Belfield, Dublin, Ireland*.

The objective of this study was to compare the milk production performance and udder health of Holstein–Friesian (HF), Norwegian Red (NRF) and Holstein–Friesian×Norwegian Red (F1) cows in first lactation. This study forms part of a 3–year on–farm crossbreeding study comprising 46 dairy herds. Milk production data was available for 1327 first lactation cows: 710 HF, 325 NRF and 292 F1. Predicted 305 d yields were obtained from the Irish Cattle Breeding Federation. These were derived using the SLAC method which adjusts for calving month, age at calving, parity and season of calving. Production data were analyzed in SAS using proc GLM and udder health data were analyzed using proc LOGISTIC. Herd, breed and calving date (udder health only) were included in the model. The 305 d milk yields of the HF and F1 were similar at 5,353 kg and 5345 kg, respectively. The NRF produced slightly less milk at 5149 kg ($P<0.001$). Fat content was highest for the HF at 4.00%, intermediate for the F1 at 3.96%, and lowest for the NRF at 3.94% ($P<0.05$). Protein content was similar for all breeds; 3.46%, 3.45% and 3.45% for the HF, NRF and F1, respectively. The NRF and F1 showed superior udder health during lactation. Compared to the HF (2.04), the F1 and NRF cows had lower somatic cell score at 1.97 ($P<0.01$) and 1.92 ($P<0.001$), respectively. The proportion of NRF cows (5.8%) with somatic cell counts averaging greater than 400,000 during lactation was lower than the HF (9.9%; $P<0.05$). That of the F1 (6.7%) tended to be lower ($P=0.097$) than the HF. The incidence of mastitis was available for 42 of the 46 herds. Fourteen percent of the HF cows had mastitis at least once during lactation, compared to 9.5% for both the F1 ($P=0.063$) and the NRF ($P<0.05$). In conclusion, based on data from year one, the F1 cows produced similar levels of milk production to the HF. Both the NRF and F1 exhibited superior udder health compared to the HF.

Key Words: Norwegian Red, Udder Health, Milk Production

225 Heritability of electronically recorded daily body weight across lactation using random regression models. J. K. Toshniwal*[1], C. D. Dechow[1], J. A. D. R. N. Appuhamy[2], and B. G. Cassell[2], [1]*The Pennsylvania State University*, *State College*, [2]*Virginia Polytechnic Institute and State University*, *Blacksburg*.

The objectives of this study were to estimate heritability for daily body weight (BW) and genetic correlations among BW at different days in milk (DIM). The Afiweigh cow body weighing system records BW of every cow exiting the milking parlor. The Afiweigh system was installed at the The Pennsylvania State University dairy herd in August of 2001 and in July of 2004 at the Virginia Polytechnic Institute and State University dairy herd. BW recorded after 365 DIM were

eliminated. Outliers were detected by generating a predicted BW curve for each cow and daily records more than four standard deviations from the curve were eliminated. The data included 202,143 observations from 575 The Pennsylvania State University and 120 Virginia Polytechnic Institute and State University Holstein cows, respectively. The random regression model in ASREML included fixed effects for age within parity, week of lactation and herd-date. Random effects included animal, permanent environment and error. The order of the polynomial was 4 for animal and 6 for permanent environment. Residual structures were grouped into the following months of lactation: 1, 2-3, 4-5, 6-8, and 9-12. Heritability estimates ranged from 0.48-0.56 and were highest between 200-230 days of lactation and lowest at 305 DIM. The genetic variance for BW declined for the first 30 DIM and climbed until the end of lactation. Genetic correlations between BW at different DIM ranged from 0.73 (DIM 0 and 100) to 1.0. The correlations among BW between early and later parts of lactation (0.83 between 0 and 305 DIM) were higher than correlations between early and mid lactation. Electronically recorded daily BW are heritable and they could be used for genetic evaluation of BW and BW change across the lactation.

Key Words: Body Weight, Heritability, Random Regression

226 Evaluation of factors affecting changes in the ranking of sires over time. A. D. Coburn*[1,2], K. A. Weigel[1], S. A. Schnell[2], and G. Abdel-Azim[2], [1]*Univeristy of Wisconsin*, *Madison*, [2]*Genex Cooperative, Inc.*, *Shawano, WI*.

Selection of sires for A.I. contract matings occurs primarily from the pool of active sires with initial progeny test results. Because high selection intensity is applied to small number of low reliability (REL) bulls, accuracy of sire evaluation significantly affects genetic progress in later generations. Our objective was to quantify mean change in rank of contract mating sires and their contemporary sires and to estimate how much of the change in rank can be attributed to redefinition of a trait or modification of the selection index. February 1999 active Holstein sires were used to determine contract mating sires and contemporary sires. Twenty-nine bulls were identified as influential mating sires with > 5 sons sampled in 2000 or later. Percentile rank of these sires was calculated annually through February 2006 for combined fat + protein (CFP), productive (PL), somatic cell score (SCS), udder composite (UDC) and Lifetime Net Merit (LNM). Mean change in rank of all active sires from 1999 to 2006 was zero for all traits. Mean absolute change in rank was 13-14% for CFP, SCS, and UDC and 20-22% for PL and LNM. The mean change in rank for contract mating sires was negative for all traits, as was mean absolute change of rank. Among subgroups based on REL of yield, bulls with high REL (>89%) tended to increase in rank for LNM, whereas bulls with intermediate (80-89%) or low (<80%) REL had negative mean change in rank with a negative skew. Multi-trait indices (MTI) were calculated weighting the aforementioned traits to mimic changes to the LNM formula in years 2000, 2003 and 2006. Mean absolute change in rank when using MTI for a given year was ≤ 8% for both sire groups. Although some change in rank can be attributed to changes in trait definition or revision of economic weights in the selection index, inaccuracy of sire evaluations for individual traits appears to contribute more significantly to the instability in rankings of A.I. contract mating sires.

Key Words: Dairy Cattle Breeding, AI Contract Mating Sires, Change in Rank

227 SNP identification in genes involved in the SREBP1 pathway in dairy cattle. J. F. Medrano* and G. Rincon, *University of California*, *Davis*.

The objective of this analysis is to identify natural sequence variations in candidate genes that determine the quantities, compositions and structures of the lipids of milk in dairy cows. We developed a strategy to detect SNPs in 6 genes in the SREBP1 pathway, which closely regulates the Stearoyl-CoA-Desaturase (SCD). The analysis consisted in re-sequencing 1000bp of the 5′UTR, coding regions and 500bp of the 3′UTR in Sterol regulatory element-binding protein-1 (SREBP1), SREBP cleavage-activating protein (SCAP), Insulin induced protein 1 (INSIG1), Insulin induced protein 2 (INSIG2, Membrane-bound transcription factor protease, site 1 (MBTPS1) and Membrane-bound transcription factor protease, site 2 (MBTPS2) genes. Vista alignments were used to identify highly conserved regions for re-sequencing. The target gene regions were resequenced in 24 animals from three dairy breeds: Holstein, Jersey and Brown Swiss. All the sampled animals were unrelated with no common ancestors in a three generation pedigree. Haploview software was used to identify linkage disequilibrium regions within the breeds and to determine tag SNPs. A total of 49 SNPs were detected and 32 were identified as tag SNPs. The number of SNPs per gene was: 7 in SREBP1, 11 in SCAP, 17 in INSIG1, 11 in INSIG2, 2 in MBTPS1 and 1 in MBTPS2. Eleven SNPs were located in exons, 7 were synonymous and 4 were non-synonymous. SIFT and Polyphen analysis were performed in the non-synonymous SNPs and two of the SNPs were classified as 'not tolerated', the first one is an amino acid change Pro/Ser in SCAP and the second one is an amino acid change Leu/Pro in the SREBP1 protein. From this analysis we have detected haplotype blocks that identify the diversity between breeds and we were able to select SNP markers that will be the basis for genotyping cows to define possible associations with milk fatty acid composition.

Key Words: SNP, Candidate Genes, Fatty Acids

228 First steps to model milk urea in a management perspective. C. Bastin*[1], A. Gillon[1], and N. Gengler[1,2], [1]*Gembloux Agricultural University*, *Gembloux, Belgium*, [2]*National Fund for Scientific Research*, *Brussels, Belgium*.

Several studies have shown that milk urea concentration is an interesting tool for herd management because of its strong links with nutritional imbalance in dietary protein. It could also be a predictor for functional traits like fertility or longevity. The objectives of this study were to estimate variance components and heritabilities for milk urea concentration during the three first lactations using a multi-lactation single-trait random regression test day model. Potentialities of predicting milk urea concentration were also studied in order to bring nutritional management tools to breeders by comparing predicted and observed productions. Available data were 3,593,575 milk urea test day concentrations from the Walloon Region of Belgium collected from 2001 to 2006. Seven herd-based random sub data sets were created and (co)variances estimation was done by REML. In order to increase usefulness of the model to predict urea for each potential test-day the classical herd - test date fixed effect was replaced by the sum of a fixed herd – year effect, a fixed herd – season effect and a random herd – test date effect as recently proposed for yield traits. Mean heritabilities estimates for milk urea were 0.21, 0.24 and 0.25 for first, second and third parity, respectively. Variances components indicated also that high variance (approximately 50% of total variance)

was associated with the random herd test-day effect. Correlations across lactations for this effect showed very high values close to 1. These results could indicate the influence of local events (e.g., diet related) covering all lactations. Results have also large implications on the predictability of successive urea records. Additional research is required to check if adapted (co)variance structures linking successive test-day records could improve predictability of urea.

Key Words: Milk Urea, Modeling, Genetic Parameters

229 Milk production, body condition score at breeding and reproductive efficiency of first lactation Holstein–Friesian, Jersey and Holstein–Friesian×Jersey cows under Irish grass–based production circumstances. R. Prendiville*[1,2], F. Buckley[1], N. Byrne[1], and M. Rath[2], [1]*Teagasc*, *Fermoy, Co. Cork., Ireland*, [2]*University College Dublin*, *Belfield, Dublin, Ireland*.

The objective of this study was to compare production, body condition score at breeding and reproductive performance of first lactation Holstein–Friesian (HF), Jersey (JE) and Jersey×Holstein–Friesian (JEX) cows across two seasonal grass–based milk production systems (low concentrate 750 kg or high concentrate 1,250 kg). The study included a total of 87 cows: 30 HF, 28 JE and 29 JEX. The mean calving date was February 19. Large differences in milk yield, fat content and protein content were observed (P<0.001). Milk yield ranged from 3836 kg for the JE to 4700 kg for the HF. The JEX produced 4294 kg. The JE had the highest milk fat content at 5.24%, compared to 3.95% for the HF and 4.67% for the JEX. Milk protein content was 3.42% for the HF, 3.71% for the JEX and 3.97% for the JE. Solids corrected milk yield (SCM) was similar for all breeds; 4387 kg, 4338 kg and 4509 kg for the HF, JE and JEX, respectively. BCS at breeding was 2.97, 3.04 and 3.13 for the HF, JE and JEX; significantly higher for the JEX compared to the HF and JE (P<0.05). Breeding started in late April and lasted 13 weeks. Mean submission rate in the first 3 weeks was 85%. Although not significantly different (due to data size), pregnancy rates observed did suggest differences in reproductive efficiency between the groups. The HF had the lowest reproductive performance (pregnancy rate to first service (PREG1) = 43%, incalf after 6 weeks breeding (PR42) = 57%, calving to conception interval (CCI) = 98 days, and number of services (NSERV) = 2.01). Comparable values for the JE and JEX were PREG1 = 64% and 65%, PR42 = 75 and 76%, CCI = 79 and 93 days, and NSERV = 1.57 and 1.55, respectively. In conclusion, first lactation results suggest that JE and JEX cows have a propensity to produce similar levels of SCM but have superior reproductive efficiency compared to the HF under Irish production circumstances.

Key Words: Milk Production, Reproductive Performance, Crossbreeding

230 Effect of service sire and cow sire on gestation length. H. D. Norman*, J. R. Wright, P. M. VanRaden, and J. B. Cole, *Agricultural Research Service, USDA*, *Beltsville, MD*.

Variance components for effect of service sire and cow sire on gestation length (GL) indicate that bull differences exist and provide an opportunity to change GL. Bull predicted transmitting abilities (PTA) for GL as either a service sire or cow sire were derived using data from >8 million calvings from 1999 through 2005. Model effects were calving year, calving herd-year, calving month, age-parity, calf birth code (gender and multiple-birth status), lactation length, milk yield, service sire, sire, and cow. All effects were fixed except service sire, sire, and cow. For bulls with ≥100 daughter records for GL, PTA were examined for all bulls (323 service sires and 397 sires with both heifer and cow records) and those in active artificial-insemination (AI) service (137 service sires and 67 sires). Standard deviations of service-sire PTA for all bulls were 1.43 d for heifer (parity 1) GL and 1.32 d for cow (parities 2 to 5) GL; corresponding standard deviations for sire PTA were 0.75 and 0.78 d. Among active-AI bulls, O-Bee Manfred Justice had the lowest PTA for daughter GL (–2.0 d) and an extremely low PTA for service-sire GL (–4.0 d); Silky Gibson had the highest PTA for daughter and service-sire GL (+2.3 d and +4.1 d, respectively). Correlation between heifer and cow service-sire PTA was 0.96 for all bulls and 0.97 for active-AI bulls; corresponding correlation for sire PTA was 0.83 for both all bulls and active-AI bulls. Correlation of sire with service-sire PTA for heifers was 0.63 for all bulls (192) and 0.49 for active-AI bulls (58); corresponding correlations for cows were 0.69 (2,441 bulls) and 0.70 (151 bulls). For bulls with ≥500 daughter records for GL, correlation of sire with service-sire PTA for cows was 0.74 for all bulls (588) and 0.69 for active-AI bulls (38). Although genetic information for GL would be useful for predicting expected calving date, substantially more research is needed to determine the potential consequences of selection for either shorter or longer GL.

Key Words: Gestation Length, Genetic Evaluation

231 Inbreeding and relationship related to genetic estimates of calf survival in one Holstein sire family. R. D. Shanks*, *University of Illinois*, *Urbana*.

Calf survival was genetically estimated by PJ Berger of Iowa State University for 271 descendants of Carlin-M Ivanhoe Bell (Bell). This included 226 sons and 45 grandsons. The purpose of this study was to evaluate the contributions of relationship to Bell, inbreeding of descendants, and inbreeding of their daughters on these estimates of survival. The model explained almost 36% of the variability in calf survival. Relationship to Bell was the most significant factor in the model ($p < 0.0001$). Genetic estimates of calf survival for sons averaged 0.0108 (standard error of 0.0004) and genetic estimates of calf survival of grandsons averaged 0.0018 (standard error of 0.0010). Genetic estimate of calf survival for Bell himself was 0.019. As expected, the genetic estimates of calf survival for descendants regressed back toward the mean of the population. Calf survival of sons was closer to estimate for Bell than that of the grandsons. Close relatives had greater resemblance for survival. The second significant factor ($p < 0.01$) was regression of genetic estimate of calf survival on inbreeding of descendants. Genetic estimate of calf survival increased 0.065 (standard error of 0.024) per one percent increase of inbreeding of descendants. Inbreeding of active AI descendants of Bell was not detrimental to the survival of their offspring. Although in this sample, the regression of genetic estimate of calf survival on daughter inbreeding was not significant ($p > 0.28$), the sign was negative, consistent with recommendation to minimize change in inbreeding in the female population. Genetic concept of resemblance between relatives is supported in this study. Consequences of inbreeding are shown to not always be detrimental. Inbreeding can be a useful genetic tool to improve calf survival.

Key Words: Genetic Estimates of Calf Survival, Inbreeding, Dairy Cattle

232 Real-time PCR quantification of reproductive hormone receptor gene expression in superovulated MOET donor cows. S. Wise*[1], M. A. Okomo-Adhiambo[1], D. Joos[1], W. Rauw[1], A. Rink[2], and L. Gomez-Raya[1], [1]*University of Nevada*, *Reno*, [2]*Animal Disease and Food Safety Laboratory*, *Reno, NV*.

Multiple ovulation and embryo transfer (MOET) facilitates production of offspring from cattle of high genetic merit world-wide. Twelve multiparous non-lactating donor cows were synchronized to estrous by intravaginal insertion of 1.38g progesterone (Eazi-Breed™ CIDR®), in addition to intramuscular injection of 1ml combination of progesterone (150mg/ml) and 17-β-estradiol (10mg/ml). Evening of day 5, 5ml FSH (Folltropin® 20mg/ml) was given intramuscular, then every 12 hrs (AM and PM) over the next 4 days. Morning and evening of day 8, corresponding to day 4 of FSH treatment, 10ml prostaglandin (Lutalyse® 5mg/ml) was given intramuscular. Morning of day 9, the last FSH shots were given and CIDR® devices removed. Cows were monitored for heat and bred thrice by AI, and embryos collected 7 days after breeding. Superovulation and embryo flushing protocol was performed twice for all cows, yielding average 0-30 embryos. Blood and serum samples for nucleic acid and hormone biochemical analysis, respectively, were taken throughout the experimental period. Quantitative real-time PCR (QRT-PCR) was used to profile expression of 5 reproductive hormone receptor genes (ESR1, FSHR, LHR, OXTR and PGR), using total RNA isolated from blood sampled over 84 hrs of FSH treatment (0h, 12h, 24h, 36h, 48h, 60h, 72h, 84h), from two cows that yielded the highest number of embryos (30 and 24, respectively) and from the cow that yielded none. All five genes were significantly over-expressed (expression ratio ≥2.0 and t-test p-value ≤0.05) in the best performing cows (#119 and #128) compared to the least performing cow (#134), in at least five of the eight experimental time-points. In cow #119 compared to #134, ESR1 was up-regulated 2- to 4-fold (0-48h) and by 10-fold at 84h, while FSHR, LHR, OXTR and PGR were significantly up-regulated at all time-points. Similar results were observed in cow #128 compared to #134, suggesting that expression of hormone receptor genes is vital to a donor cow's physiological response to reproductive hormone treatments administered for superovulation.

Key Words: MOET, Reproductive Hormone Receptor Genes, Quantitative real-time PCR

233 Poisson versus logit models for genetic analysis of mastitis in Norwegian cattle. A. I. Vázquez*[1], K. A. Weigel[1], D. Gianola[1], D. M. Bates[1], and B. Heringstad[2], [1]*University of Wisconsin*, *Madison*, [2]*Norwegian University of Life Science*, *Ås, Norway*.

Clinical mastitis incidence is typically coded as presence/absence during some period of exposure, and records are analyzed with linear or logit models. Since "presence" includes cows with multiple episodes, there is a loss of information when a count is treated as a binary response. Poisson (P) and logit (L) mixed models were fitted to clinical mastitis records on 36,178 first-lactation daughters of 245 Norwegian Red sires distributed over 5,286 herds. An R implementation (lme4 package) was modified to allow for correlations between random effects, such that pedigree information could be included. Since 26% of the cows had lactations shorter than 300 d, the log of days in milk (DIM) was included via the function log(λ*DIM)=fixed+herd+sire effects, were λ is the per-day Poisson parameter peculiar to a record. Predictive ability of models was assessed via a two-fold cross-validation using mean squared error (MSE) as end-point. On average, there were 0.295 cases of mastitis per cow; 77% of the cows did not have the disease, and only about 1% of the cows had 3 or more episodes during lactation. Between-sire variance estimates were 0.065 in P and 0.093 in L. The ratio between herd and sire variances was 4.6 and 3.7 for P and L models, respectively. The correlation between predicted random effects from the two models was 0.95 and 0.94 for sires and herds, respectively. Predictive MSE for all data was smaller for the Poisson model: 0.346 vs. 0.351. Within healthy animals, MSE was 0.053 (L) and 0.085 (P). For animals with 1 case, MSE values were 0.583 (L) and 0.499 (P). For animals with 2 cases, and 3 or more cases, the P model also had a better predictive performance. The cross-validation suggested a better overall performance of the Poisson model over the logit model, primarily due to improved predictive ability within diseased animals. The P model may be even better in situations in which the disease is more prevalent.

Key Words: Mastitis, Poisson, Threshold

Companion Animals: Companion and Comparative Animal Nutrition

234 Effect of gut-loading time on nutrient content of adult feeder crickets. C. L. Dikeman*, S. D. Plesuk, D. L. Klimek, and L. G. Simmons, *Omaha's Henry Doorly Zoo*, *Omaha, NE*.

Insectivorous amphibians and reptiles in captivity are typically limited to diets consisting primarily of feeder crickets. Without supplementation, farmed feeder crickets lack proper nutrient profiles to sustain the health of preying animals. While gut-loading of crickets is common practice among herpetologists, management of gut-loading crickets is poorly defined. The objective of this experiment was to determine optimal gut-loading time to best improve the nutrient profiles of feeder crickets for amphibians and reptiles in captive environments. Farmed crickets (*Acheta domesticus*) were purchased from a vendor (The Bug Company, Ham Lake, MN) and fed a commercial high-calcium cricket diet (PMI, St. Louis, MO) for 24, 48, 72, or 168 h, in a replicated block design. Dry matter (DM) concentrations of crickets gut-loaded for 24, 48, or 72 h (31.7, 31.5, and 31.8%, respectively) were higher (P<0.05) compared with 168 h (30.1%). No differences were detected for organic matter (OM), crude protein (CP), acid-hydrolyzed fat (AHF), or crude fiber (CF) concentrations among gut-loading treatments. Calcium concentrations were higher (P<0.05) after crickets were gut-loaded for 24 h (1.39%) compared with 48, 72, or 168 h (0.42, 0.37, and 0.66%, respectively). Magnesium concentrations were higher (P<0.05) after gut-loading crickets for 24 or 168 h (0.20 and 0.18%, respectively), compared with 48 or 72 h (0.10 and 0.09%, respectively). Concentration of manganese in crickets was higher (P<0.05) after 24 h (59.5 ppm) compared with crickets gut-loaded for either 48 or 72 h (28.5 and 27.0 ppm, respectively). No differences were detected in concentrations of sulfur, phosphorus, potassium, sodium, iron, copper, or zinc. Overall, gut-loading crickets for 24 h appeared more effective in increasing mineral concentrations compared with other time treatments. Further research is needed to completely elucidate the most effective strategies to increase nutritive value of feeder crickets for captive amphibians and reptiles.

Key Words: Reptile, Amphibian, Minerals

235 Effect of supplement type on mineral content of feeder crickets and growth of leaf-tailed geckos. C. L. Dikeman*[1], S. Plesuk[1], A. Koraleski[1], A. DeVries[1], K. Bilof[2], D. Klimek[1], J. Krebs[1], and L. G. Simmons[1], [1]*Omaha's Henry Doorly Zoo*, *Omaha, NE*, [2]*University of Illinois*, *Urbana*.

Current methods of supplementation for feeder crickets to insectivorous reptiles in captivity include gut-loading and/or dusting with powders. Two experiments were conducted to address effects of supplement type on mineral content of feeder crickets and growth of captive geckos. In a replicated complete block design, farmed crickets were purchased (The Bug Company, Ham Lake, MN) and assigned to 1 of 4 dietary treatments including: fasted for 24 h (F), gut-loaded with Mazuri® high-calcium cricket diet (PMI, St. Louis, MO) for 24h (GL), gut-loaded plus dusted with Herptivite™ (RepCal Research Labs, Los Gatos, CA) (GLH) or gut-loaded plus dusted with MinerAll™ (Sticky Tongue Farms, Romoland, CA) (GLM). In Experiment 2, 6 newly hatched geckos (*Uroplatus sikorae*) were randomly assigned to GL, GLH, or GLM treatments. Geckos were fed ad lib, weights and lengths were measured weekly for 4 months. Concentrations of sulfur and iron were higher (P<0.05) in GLH crickets (0.72 %, 1,168 ppm, respectively) compared with other treatments. Calcium concentration was higher (P<0.05) in GLM crickets (6.37%) compared with other treatments (2.3, 2.4, and 2.9% for GLH, GL, and F, respectively). GL crickets had higher (P<0.05) concentrations of phosphorus (1.28%) compared with F (0.98%). Potassium was higher (P<0.05) in GLH (1.78%), GL (1.75%) and GLM (1.44%) compared with F (1.18%). Sodium concentrations were higher (P<0.05) in GLH and GL treatments. Manganese concentrations were higher (P<0.05) in both GLH (148.5 ppm) and GLM (128.5 ppm) compared with GL (49 ppm). No other differences were detected. Average weight of geckos fed GLH (2.5 g) was lower (P<0.05) than average weights of geckos fed GL or GLM (2.8 g). Mean percent gain ranged from 33 to 38.5% for GLH, and GL, respectively. All treatments supported weight gain; however, enough data are not available to conclusively demonstrate benefits of these treatments in this species.

Key Words: Gecko, Cricket, Mineral

236 Serum nutrient concentration comparisons between free-ranging and captive giraffe (*Giraffa camelopardalis*). D. A. Schmidt*[1,2], M. R. Ellersieck[3], and M. E. Griffin[4], [1]*Lincoln Park Zoo*, *Chicago, IL*, [2]*Zoological Society of San Diego*, *San Diego, CA*, [3]*University of Missouri*, *Columbia*, [4]*Purina Mills, LLC*, *Saint Louis, MO*.

Serum concentrations of amino acids, fatty acids, lipoproteins, vitamins A and E, and minerals in captive giraffe were compared to values obtained from free-ranging giraffe in an effort to identify potential nutrient problems in the captive population. Captive giraffe have a specific set of maladies, including peracute mortality, energy malnutrition, pancreatic disease, urolithiasis, hoof disease, and severe intestinal parasitism, which may be related to basic nutritional inadequacies. Dietary requirements for giraffe are not known; invasive studies used with domestic animals can not be performed on zoo animals. Though domestic animal standards are often used to evaluate nutritional health of exotic animals, they may not be the most appropriate standard to use. Twenty serum samples from captive giraffe at 10 zoological institutions in the United States were compared to previously collected samples from 24 free-ranging giraffe in South Africa. Thirteen of the captive animal samples were collected from animals trained for blood collection. Seven were banked samples obtained from previous serum collections while animals were under anesthesia. Dietary information was also collected on each captive giraffe. Most captive giraffe diets consisted of alfalfa-based pellets and alfalfa hay. Differences between captive and free-ranging giraffe, males and females, and adults and sub-adults were analyzed using a $2 \times 2 \times 2$ factorial and Fisher's LSD for mean separation. Of the 84 parameters measured, 54 (60%) were different ($P \leq 0.05$) between captive and free-ranging giraffe. Nine (11%) items were different ($P \leq 0.05$) between adult and sub-adult animals. Only one parameter, sodium concentration, was found to be different ($P \leq 0.05$) between genders. Diets for captive giraffe need further investigation to address the differences seen in this study and the potentially related health problems.

Key Words: Giraffe, Nutrition

237 Nutrient digestibility and fecal characteristics of exotic felids fed a beef-based raw diet. B. M. Vester*[1], S. L. Burke[2], C. L. Dikeman[2], L. G. Simmons[2], and K. S. Swanson[1], [1]*University of Illinois*, *Urbana*, [2]*Henry Doorly Zoo*, *Omaha, NE*.

Nutrient digestibility has been well studied and characterized in many of our domestic species; however, little has been done to evaluate digestibility in exotic felids. Large exotic felid species in captivity are often fed diets extrapolated from the requirements of the domestic cat. Furthermore, little research has been published determining the nutrient content of diets fed to these animals. The objective of this experiment was to evaluate differences in nutrient digestibility and fecal characteristics in five species of large exotic captive felid species at the Henry Doorly Zoo. The five species evaluated included Bobcats (n=2), Jaguars (n=4), Cheetahs (n=5), Indochinese Tigers (n=4), and Siberian Tigers (n=5). All animals were individually housed and adapted to beef-based raw diet (Nebraska Brand® Special Beef Feline) for 16 d. Total fecal collections were conducted on d 17 through 20. Fecal samples were weighed and scored upon collection. Scores were determined on a 5 point scale (1= hard, dry pellets; 2, dry, well formed stools; 3, soft, moist, formed stool; 4, soft, unformed stool; 5, watery, liquid that can be poured). Diet and fecal samples were evaluated for dry matter, organic matter, protein, fat, and energy to determine digestibility. A fresh fecal sample was collected to determine fecal pH. Fecal scores were greater (P<0.01) in Indochinese Tigers when compared to all other species, and Cheetahs had greater (P<0.01) fecal scores than Jaguars and Bobcats. Dry matter, organic matter, and protein digestibility were not different among species. Fat digestibility was greater (P<0.01) in Siberian Tigers, Indochinese Tigers, and Bobcats (0.96) compared to Cheetahs and Jaguars (0.94). Digestible energy tended to be lower (P<0.10) in Jaguars and Cheetahs (0.92) compared to Bobcats and Indochinese Tigers (0.93). Fecal pH was greater (P<0.01) in Bobcats (ph=8) compared to all other species evaluated (ph=6). Overall, the beef-based raw diet was highly digestible in all species. However, differences in fat and digestible energy, suggests that further work should be completed to elucidate the differences between these species.

Key Words: Digestibility, Exotic Felid

238 Influence of dietary protein content and source on digestibility patterns and fecal osmolality in dogs differing in body size. J. Nery*[1], C. Tournier[2], V. Biourge[2], H. Dumon[1], and P. Nguyen[1], [1]*École Nationale Vétérinaire de Nantes*, *Nantes, France*, [2]*Royal Canin*, *Aimargues, France*.

Large breed dogs have frequently poorer fecal quality than smaller ones when given the same diet. Previous work indicated that this difference would be due, at least in part, to differences in fermentation and a higher osmolality in the hindgut chyme of large dogs. As we hypothesized that diet formulation could alter these differences, the aim of this study was to assess the effect of protein source and level on digestibility, fecal quality and osmolality in dogs differing in body size. 24 female dogs (2.75 to 32.10 kg BW) were used. Two diets were tested in a cross-over design. The main protein source of diet A was poultry and poultry by-products (ME=15.7 MJ/kg, CP=35.2%, fat=16.0%, TDF=7.7%, Na=3.45 and K=5.17mg/g DM) and the one of diet B was wheat gluten (ME=16.2 MJ/kg, CP=19.9%, fat=18.0%, TDF=9.0%, Na=3.85 and K=8.67mg/g DM). Fecal scores and DM, energy, fat, CP, ash, Na and K apparent digestibility coefficient (ADC) were determined. Fresh stools were analyzed for fecal osmolality. Data was statistically analyzed using ANOVA. Fecal score and moisture were higher in dogs fed on diet A and larger dogs had softer stools than smaller ones. ADC of DM, energy, fat, CP and ash was consistently higher for diet B. Differences among dogs' size were found to be higher for DM ($p \leq 0.0001$), energy ($p \leq 0.001$), CP ($p \leq 0.001$) and ash ($p \leq 0.05$) considering diet B. ADC of Na did not vary with dogs' size nor with diet while ADC of K varied both with dogs' size ($p \leq 0.05$) and diet ($p \leq 0.0001$), being higher for diet B. Osmolality was consistently higher for diet A ($p \leq 0.0001$) with differences also found between dogs' size ($p \leq 0.05$). This study showed that lower ADC of K and higher fecal osmolality would stimulate a lower water absorption in the hindgut promoting softer stools. A lower content and higher ADC of protein in the diet ameliorated fecal quality. Decreasing protein content in the diet and increasing its ADC would thus improve large dogs' feces quality.

Key Words: Dog, Protein, Digestibility

Dairy Foods: Cheese I

239 Chemical changes that predispose smoked cheddar cheese to calcium lactate crystallization. P. Rajbhandari*, J. Patel, E. Valentine, and P. S. Kindstedt, *University of Vermont*, *Burlington*.

We have observed a high incidence of calcium lactate surface crystals on naturally smoked Cheddar cheese in the retail marketplace. The objective of this study was to identify chemical changes that may occur during natural smoking which render Cheddar cheese more susceptible to calcium lactate crystal formation. Nine random weight (ca. 300 g) retail-packaged samples of smoked Cheddar cheese were obtained from a commercial manufacturer immediately after the samples were smoked for ca. 6 h at ca. 20°C in a commercial smokehouse. Three similarly sized samples that originated from the same 22-kg block of cheese and that were not smoked were also obtained. Within 2 d after smoking (0 wk), 3 smoked and 3 non-smoked samples were sectioned into 5 sub-samples at different depths representing 0-2, 2-4, 4-6, 6-8, and 8-10 mm from the cheese surface. Six additional smoked cheese samples were similarly sectioned at 4 wk and again at 10 wk of storage at 5°C. Sample sections were analyzed for moisture, pH, L(+) and D(-) lactate, and water soluble calcium. The effects of treatment (smoked, non-smoked), depth from cheese surface and their interactions were analyzed by ANOVA according to a repeated measures design with 2 within subjects variables. Smoked samples contained significantly lower moisture and lower pH, and higher lactate-in-moisture (LIM) and water-soluble calcium-in-moisture (WSCIM) than non-smoked samples at 0 wk. Smoked samples also contained significant gradients of moisture, pH, LIM and WSCIM, with lower moisture and pH, and higher LIM and WSCIM, occurring at the cheese surface. Gradients of moisture were still present in smoked samples at 4-and10 wk of storage. In contrast, the pH, LIM and WSC equilibrated and showed no gradients at 4 wk and10 wk. The results indicate that calcium and lactate in the serum phase of the cheese were elevated as a result of smoking, especially at the cheese surface immediately after smoking treatment, which presumably predisposed the smoked cheeses to increased susceptibility to calcium lactate surface crystallization.

Key Words: Cheddar Cheese, Calcium Lactate, Crystals

240 Nucleation and growth rates of calcium lactate crystals on smoked cheddar cheese. 1. Effect of storage temperature. J. Patel*, P. Rajbhandari, E. Valentine, and P. S. Kindstedt, *University of Vermont*, *Burlington*.

Previous studies have shown that storage temperature influences the formation of calcium lactate crystals on Cheddar cheese surfaces. However, the mechanisms by which crystallization is modulated by storage temperature are not completely understood. The objectives of this study were to evaluate the effect of storage temperature on: 1) the number of discrete visible crystals formed per unit of cheese surface area; 2) growth rate and shape of discrete crystals (as measured by radius, area and circularity); 3) percentage of total cheese surface area occupied by crystals. Three vacuum packaged random weight (ca. 300 g) retail samples of naturally smoked Cheddar cheese, produced from the same vat of cheese, were obtained from a retail source. The samples were cut parallel to the longitudinal axis at a depth of 10 mm from the 2 surfaces to give six 10-mm thick slabs, 4 of which were randomly assigned to 4 different storage temperatures: 1, 5, 10°C, and weekly cycling between 1 and 10°C. Samples were stored for 30 wk. Following the onset of visible surface crystals, digital photographs of surfaces were taken bi-weekly and evaluated by image analysis for number of discrete crystal regions and total surface area occupied by crystals. Also, specific discrete crystals were chosen and evaluated bi-weekly for radius, area and circularity. The entire experiment was conducted in duplicate. The effects of storage time and temperature on crystal number and total crystal area were evaluated by ANOVA according to a repeated measures design. Crystal number and total crystal area increased significantly during storage in a temperature-dependent manner as follows: 5°C<1°/10°C<10°C<1°C. However, storage temperature did not appear to have a major effect on the growth rates and shapes of the individual crystals that were chosen for analysis. The data indicated that storage temperature primarily affected the number of nucleation sites on the cheese surface that subsequently developed into discrete visible crystals.

Key Words: Cheddar Cheese, Calcium Lactate, Crystal

241 Nucleation and growth rates of calcium lactate crystals on smoked cheddar cheese. 2. Effect of packaging tightness. E. Valentine*, P. Rajbhandari, J. Patel, and P. S. Kindstedt, *University of Vermont*, *Burlington*.

Previous studies have shown that loose packaging favors the formation of calcium lactate crystals on the surface of Cheddar cheese. However, the mechanism by which crystallization is accelerated by loose packaging is not well understood. The objectives of this study were to evaluate the effect of packaging tightness on: 1) the number of discrete visible crystals formed per unit of cheese surface area; 2) growth rate and shape of discrete crystals (as measured by radius, area and circularity); 3) percentage of total cheese surface area occupied by crystals. Three vacuum packaged random weight (ca. 300 g) retail samples of naturally smoked Cheddar cheese, produced from the same vat of cheese, were obtained from a retail source. The samples were cut parallel to the longitudinal axis at a depth of 10 mm from the surface to give six 10-mm thick slabs, 3 of which were randomly assigned to 3 different levels of packaging tightness: 10 mbar (very tight), 70 mbar (slightly loose) and 960 mbar (very loose). Samples were stored at 1°C for 30 wk. Following the onset of visible surface crystals, digital photographs of the external smoked surfaces were taken bi-weekly and evaluated by image analysis for number of discrete crystal regions and total surface area occupied by crystals. Also, specific individual crystals were chosen and evaluated bi-weekly for radius, area and circularity. The entire experiment was conducted in duplicate. The effects of storage time and packaging tightness on crystal number and total crystal area were evaluated by ANOVA according to a repeated measures design. Loose packaging caused large, significant increases in the number of discrete crystals formed per unit of surface area and the total surface area occupied by crystals. However, packaging tightness did not appear to have a major effect on the growth rates or shapes of individual crystals that were chosen for analysis. The data indicate that loose packaging primarily increased the number of nucleation sites on the cheese surface that subsequently developed into discrete visible crystals.

Key Words: Cheddar Cheese, Calcium Lactate, Crystal

242 Nucleation and growth rates of calcium lactate crystals on smoked cheddar cheese. 3. Effect of cheese surface. J. Patel*, E. Valentine, P. Rajbhandari, and P. S. Kindstedt, *University of Vermont*, *Burlington*.

Previous studies have suggested that the surface characteristics of Cheddar cheese may affect the development of calcium lactate crystals. The surface of Cheddar cheese is altered considerably during natural smoking, which may contribute to the high incidence of crystallization observed in retail samples of smoked Cheddar. The objective of this study was to compare crystal nucleation and growth rates on the external surface (exposed to smoking) and a subsurface cut 10 mm below the external surface after smoking (not exposed to smoking) during storage under 4 different temperature conditions. Three vacuum packaged random weight (ca. 300g) retail samples of naturally smoked Cheddar cheese, produced from the same vat of cheese, were obtained from a retail source. The samples were cut parallel to the longitudinal axis at a depth of 10 mm from the 2 surfaces to give six 10-mm thick slabs, 4 of which were randomly assigned to 4 different storage temperatures: 1, 5, 10°C, and weekly cycling between 1 and 10°C. Samples were stored for 30 wk. Following the onset of visible surface crystals, digital photographs of the external surfaces and subsurfaces were taken bi-weekly and evaluated by image analysis for number of discrete crystal regions and total surface area occupied by crystals. Also, specific individual crystals were chosen and evaluated bi-weekly for radius, area and circularity. The entire experiment was conducted in duplicate. The effects of cheese surface, storage temperature and storage time on crystal number and total crystal area were evaluated by ANOVA according to a repeated measures design. The number of crystals and total surface area occupied by crystals were significantly higher at the external surface compared to the subsurface. Onset of visible crystals at the subsurface was delayed by ca. 20 wk compared to the external surface. However, the growth rates and shapes of the individual crystals selected did not appear to differ greatly. The data suggest that the surface of naturally smoked cheese is altered in a manner that favors nucleation site formation, increased crystal number and early onset.

Key Words: Cheddar Cheese, Calcium Lactate, Crystal

243 Influence of native pasture feeding time on conjugated linoleic acid content in Ragusano cheese. S. La Terra*[1], V. M. Marino[1], S. Carpino[1], M. Manenti[1], and G. Licitra[1,2], [1]*CoRFiLaC, Regione Siciliana*, *Ragusa, Italy*, [2]*D.A.C.P.A., Catania University*, *Catania, Italy*.

Ragusano PDO is an aged pasta filata cheese. It is a farmstead traditional cheese with unique aroma characteristics correlated to the environmental conditions and traditional cheese making technology. In 1996, Ragusano cheese has been designated PDO from the European Economic Community. It has been reported that dairy cows fed native pasture produce milk and consequently cheese with higher CLA content then dairy cows fed total mixed ration including forages with similar lipid content. The most representative CLA isomer is the cis-9, trans-11, and it generally constitutes 80%-90% of total CLA. The objective of this study was to determine the effect of Hyblean native pasture diet on conjugated linoleic acid (CLA) isomers content into Ragusano cheese at different ripening stages. The identification of CLA isomers in cheese was performed by silver ion high performance liquid chromatography. As expected, no variation in CLA content and isomers was observed in cheese samples analyzed at 90-120-210 days of ripening (913,80-925,32-901,09 ng/mg fat). Confirming previous data, the results clearly showed a direct relationship between native pasture and fat level of CLA in milk and cheeses produced from grazing animals. We also found that concentration of the total CLA and the cis-9, trans-11 increased with grazing time. We detected a double CLA level in cheeses produced with milk from cows grazing longer time (1288,33 ng/mg fat with 6 hours grazing vs 2459,39 ng/mg fat with 12 hours grazing). The quality of pasture is very important for the CLA content in fact the highest value of CLA occurs in native pasture than cultivate pasture. The high level of isomers of CLA could also be considered as an additional indicator for the authenticity of raw milk cheese from cows fed native pasture (P.D.O. marker).

Key Words: Conjugated Linoleic Acid, Cheese, Pasture

244 Novel approach for producing process cheese with reduced fat and reduced sodium content. L. E. Metzger and R. Kapoor*, *Midwest Dairy Foods Research Center*, *St. Paul, MN*.

The objective of the present study was to develop a novel commercially feasible approach for producing a process cheese with reduced fat and

reduced sodium content. The first objective of the present study was to develop a reduced fat reduced sodium Cheddar cheese (RFC) with modified manufacturing protocol to render a cheese that (after 1 wk of ripening) has a similar texture to full fat regular sodium Cheddar cheese. The second objective of the present study was to formulate a low-sodium-reduced-fat process cheese (LSRF) utilizing RFC and other ingredients so as to achieve a process cheese with a reduced fat and a reduced sodium content that has similar sensory and textural properties to commercial process cheeses. Results from the present project have indicated a successful production of LSRF. The final chemical properties of LSRF including its moisture, fat, sodium, and potassium were 50%, 10%, 280 mg/100g, and 1277 mg/100g respectively. Utilization of RFC as the cheese base facilitated in preventing LSRF from having a rubbery and crumbly texture typically associated with reduced fat process cheeses. One of the highlights of LSRF is the elimination of the bitter-metallic off-flavor that is typically found in reduced sodium products where potassium chloride is used as a salt substitute. Another highlight of LSRF is the enhanced cheese flavor notes that help in overcoming the typical bland flavor associated with low sodium and/or low fat cheeses. Along with RFC, that formed the major ingredient for LSRF, other ingredients such as tri-potassium citrate, maltodextrin, guar gum, and water provided LSRF with desirable texture. The ingredients that aided in enhancing the sensory properties of LSRF included a variety of cheese flavors, savory flavor-enhancer, potassium chloride based salt substitute, sugar, and lactic acid. The present approach was successful in producing a sliceable process cheese with a low sodium content (140 mg/serving) and up to 67 % reduced fat content without significantly affecting its sensory and textural properties.

245 Influence of starter bacteria and salt to moisture ratio on calcium lactate crystal formation. S. Agarwal*, J. R. Powers, S. Chen, B. G. Swanson, and S. Clark, *Washington State University*, *Pullman*.

Occurrence of L(+)-lactate crystals in hard cheeses continues to be an expense to the cheese industry. Salt tolerance of starter bacteria and salt to moisture ratio (S/M) in cheese dictates final pH of cheese, which can influence CLC formation. The research investigates the effects of (S/M) and starter bacteria on cheese pH and occurrence of CLC. A commercial starter was selected based on its sensitivity to S/M below and above 4.0 S/M. Cheddar cheese was made using either whole milk (3.25% protein, 3.85% fat, 4.74% lactose) or whole milk supplemented with ultrafiltered milk and cream (4.5% protein, 5.3% fat, 4.78% lactose). Calculated amounts of salt were added at milling (pH 5.40 ± 0.02) to obtain cheeses with low (3.5) and high (4.5) S/M. The cheeses were either vacuum packaged or gas flushed with CO2 and aged at 7.2oC for 3 months. Total and soluble calcium, lactic acid and pH were measured and CLC were observed in all cheeses for 3 months. Low and high salt concentrated milk cheeses (LSCMC and HSCMC), had 36% higher total calcium (1219 mg/100g and 1257 mg/100g cheese, respectively), than low and high salt whole milk cheeses (LSWMC and HSWMC; 908 mg/100g and 917 mg/100g of cheese, respectively). Soluble calcium was 29% higher in LSWMC and LSCMC (438 mg/100g and 454 mg/100g cheese, respectively) compared to HSWMC and HSCMC (339 mg/100g and 354 mg/100g cheese, respectively). Concentration of lactic acid in high salt cheeses ranged from 0.70 to 0.74%, while that in low salt cheeses ranged from 1.86 to 1.97% at the end of 3 months. CLC were observed in all low salt cheeses but highest intensity of CLC were observed in cheeses made with milk with high protein concentration and gas flushed packaging. These results confirm that occurrence of CLC formation is dependent on cheese milk concentration and cheese pH, which can be influenced not only by S/M but also by cheese microflora.

Key Words: Calcium Lactate Crystals, Starter Bacteria, Cheddar Cheese

246 Utilization of plant proteinase from Jack fruit *(Artocarpus integrifolis)* to accelerate the ripening of RAS cheese slurry as a functional food. E. E. El Tanboly* and M. A. El Hofi, *National Research Center*, *Dokki, Cairo, Egypt*.

The aim of the present work was to search for a novel plant proteinase enzyme from Jack fruit *(Artocarpus integrifolis)* as a source of protolytic enzymes to accelerate the ripening of Ras cheese slurry as a functional food. Plant proteinase would be natural products, which can be easily extracted at relatively low cost and no legal barriers. This enzyme was subjected to a purification scheme composed of ammonium sulfate fractionation followed by gel filtration on G-100 Sephadex column and purified proteinase properties was studied such as optimum incubation temperature and optimum incubation time, energy of activation, optimum pH, Thermal and pH stability, Michaelis-constant of (Km) values and Effect of metal ions and chemical reagents on enzyme. Crud extracted proeinase was used to accelerate ripening of Ras cheese slurry with concentration of 1 and 2 ml/100 g curd. Slurries were incubated at 37°C for 7 days. The results indicated that the ripening indices of slurries (SN/TN, tyrosin and tryptiphane) gradually increased as rate of enzyme increased and as ripening period progressed. Also, flavour of all slurries gradually improved during incubation period. At the end of incubation period slurry with 2 ml/100g curd had a high flavour scoring.

Key Words: Jack Fruit (*Artocarpus integrifolis*), Proteinase Enzyme, RAS Cheese Slurry

Egg and Meat Science and Muscle Biology - Livestock and Poultry: Meat Marination

247 Impact of functional ingredients on food safety. S. R. McKee*[1], C. Z. Alvarado[2], and J. W. Bowers[1], [1]*Auburn University*, *Auburn*, [2]*Texas Tech University*, *Lubbock*.

The most commonly used poultry marinades include salt and sodium tripolyphosphates which have been shown to increase meat yield, as well as improve color, water holding capacity, and texture. Recently, several poultry further processing facilities have begun using more acidic (pH ~ 4) type marinades such as sodium lactate (SL), sodium citrate (SC), and sodium diacetate (SD) (alone or in combination) to combat the growth of Listeria monocytogenes in further processed loaves. Since these acidic marinades currently used in turkey further processing have a low pH (~ 4) compared to the previously used salt and sodium tripolyphosphates (~ pH 9), these marinades may alter meat quality attributes. Current research suggest that sodium diacetate can inhibit the growth of LM during refrigerated storage, but the inclusion of this ingredient may alter the product's cohesiveness and

moisture retention. Meat quality traits and microbial analyses from inclusion of LM inhibitors alone and in combination in the formulation of turkey deli loaves and beef franks will be presented.

Key Words: Functional Ingredients in Further Processing, Listera Growth Inhibitors, Food Safety

248 Impact of marination and deboning time on poultry meat tenderness. C. M. Owens*, *University of Arkansas*, *Fayetteville*.

Marination is an increasing popular trend in the meat industry for meat quality enhancement. Sodium chloride or salt, an important component of the meat marinade solution, helps solubilize proteins to increase water-holding capacity, improves tenderness, and enhances flavor. However, there are concerns of increased sodium intake in consumer diets. Studies were conducted to determine the effectiveness of marination and level of salt concentration to improve tenderness and enhance juiciness and flavor of broiler breast fillets. In these studies, fillets were deboned at various times postmortem ranging from 0.25h to 24h postmortem and marinated with varying levels of salt (0 to 1.25%) salt (NaCl) and 0.45% phosphate in a 15% marinade solution. Cooked fillets were subjected to instrumental analyses including the MORS test for assessing tenderness as well as sensory analysis using hedonic and Just About Right scales to assess tenderness, juiciness, saltiness and flavor. All marinated treatments were significantly more tender than non-marinated controls. Using instrumental tenderness analysis, salt concentrations above 1.0% were more tender than other treatments; however, all marinated treatments were significantly more tender than non-marinated controls. Using the hedonic scale, there was no significant difference in marinated products (0.5% to 1.25% salt) for overall impression, flavor, and texture. However, fillets with the higher concentrations of salt (1% and 1.25%) resulted in high percentages of consumers who considered the product too salty. For juiciness and tenderness, a large percentage (>70%) of the consumers considered 0.5%, 0.75%, and 1% treatments to be just about right. The results indicate that marination of pre-rigor deboned meat is effective in producing product similar to marinated post-rigor deboned meat. While meat marinated with higher concentrations of salt may give more desirable levels of tenderness, there is a greater chance of a negative impact on flavor and saltiness in the end product. Furthermore, it is possible to marinate with lower concentrations of salt while still improving meat characteristics and keeping ingredient costs low.

Key Words: Marination, Salt, Tenderness

249 Characterizing the safety and quality of fresh beef cuts subjected to deep muscle marination. M. M. Brashears*, J. C. Brooks, and M. F. Miller, *Texas Tech University*, *Lubbock*.

In May 2005, USDA-FSIS published notice that establishments who produce non-intact beef products must reassess their HACCP plans because outbreaks indicate that *Escherichia coli* O157:H7 is a hazard reasonably likely to occur in these products. USDA-FSIS suggested that processors might also consider applying an allowed antimicrobial agent to the surface of the product prior to processing or tenderization. Research has shown that lactic acid bacteria (LAB) and acidified sodium chlorite (ASC) are effective at reducing pathogens in ground beef. Lactic acid spray (LAS) has also been shown to reduce pathogens when applied to beef trim. Information on the use of these interventions and their effect on the palatability of whole muscle beef products intended for enhancement is limited. Therefore, the objectives of this research were to validate the effectiveness of LAB, ASC, and LAS in reducing *Escherichia coli* O157:H7 and *Salmonella* spp in multi-needle injected and marinated beef strip loins, and to determine their effect on meat palatability. Boneless beef strip loins were transported to Texas Tech University and inoculated with a cocktail mixture of streptomycin-resistant *Escherichia coli* O157:H7. Loins were inoculated at a 10^4 level (high) to determine actual log reductions and a 10^1 level (low) to mimic potential industry levels. One-half of the low and high level inoculated samples were treated with lactic acid bacteria (1×10^9 cfu/g meat), acidified sodium chlorite (1000 ppm) or lactic acid (3%). Control and inoculated loins were vacuum packaged and stored at 2 to 4 °C in the dark for 14 and 21 d. Following the aging period, the remaining low and high level inoculated subprimals were treated with LAB, ASC or LAS. All subprimals were then injected with a brine solution formulated to provide 0.3% sodium chloride, 0.35% phosphate and 0.05% rosemary extract in the final product at a 10% injection level. Additional loins were transported to a separate facility and subjected to the same treatments, storage and enhancement prior to trained sensory panel assessment of flavor, flavor intensity, juiciness and tenderness.

Key Words: Marinate, Beef, Safety

Food Safety - Livestock and Poultry: Cattle and Swine

250 Beef traceability using a dual system based on electronic identification and molecular markers from farm to retailer. J. J. Ghirardi, G. Caja*, M. Hernández-Jover, N. Jiménez, and A. Sánchez, *Universitat Autònoma de Barcelona*, *Bellaterra, Spain*.

A total of 3,657 crossbreed calves on 14 farms in Barcelona and Lleida (Spain) were used to evaluate the efficiency of a dual traceability system based on electronic identification (e-ID), by radiofrequency boluses containing low-frequency (LF; 134.2 kHz) half-duplex 32 mm transponders (Rumitag, Barcelona, Spain), and genetic fingerprinting (DNA) by analyzing specific sets of bovine microsatellites (n = 12) from frozen biopsies. The e-ID of calves was done during the milk-feeding period using either B1 (75 g; 21 × 68 mm; n = 3,057) or B2 (73 g; 18 × 77 mm; n = 600) boluses. High-frequency (HF; 13.56 MHz) read-write inlay transponder (45 × 76 mm; Tiris, Almelo, Holland) were used for transferring e-ID to the carcasses. All animals had official ear tags (OE) made of polyurethane (2 flaps; 10.1 g; Azasa-Allflex, Madrid, Spain). Ear biopsies were taken using biopsying ear tags: E1 (n = 2,562; Biopsytec, Rheinbach, Germany) and E2 (n = 1,095; TypiFix, IDnostic, Switzerland). Calves were intensively fed and slaughtered before 1 yr of age. Blank read-write HF labels were attached to the calf shank before hide removal. Bolus LF code was transferred to the carcass by automatic reading of LF boluses and recording of HF shank labels. Carcass samples (n = 900) were taken using biopsy tubes (n = 357; Biopsytec) or plastic sticks (n = 543; Identigen, Dublin, Irland). Additionally, E2 sticks were used to sample 30 meat cuts randomly taken in nine butcheries. On-farm traceability

for B1 (99.8%) and B2 (100%) was greater than for all ear tags (OE, 96.4%; E1, 8.4%; and, E2, 99.1%). On-line readings failed in 37% of cases at the start of the experiment, suggesting the need for modifications of the equipment to adapt to the abattoir conditions. Automatic reading and label recording in the rest of the animals (n = 2,058) was 98.6% successful. When tracing back carcasses to calves in 176 random samples, five pairs (2.8%) did not match, showing 97.2% calf traceability. Retailer matching was 100%. In conclusion, the e-ID and DNA tracing system showed > 97% traceability efficiency. Improvement in label design and reading equipment is needed in practice.

Key Words: Traceability, Transponder, Microsatellites

251 Siderophore receptor/porin protein (SRP®) vaccine used as pre-harvest control of *E. coli* O157:H7 in feedlot cattle. A. B. Thornton*[1], D. U. Thomson[1], K. F. Lechtenberg[2], G. H. Loneragan[3], and T. G. Nagaraja[1], [1]*Kansas State University*, *Manhattan*, [2]*Midwest Veterinary Services*, *Oakland, Nebraska*, [3]*West Texas A&M University*, *Canyon*.

Yearling steers and heifers (n = 1,252) were used to examine effects of Siderophore receptor/porin protein (SRP) *E. coli* O157:H7 vaccine on fecal prevalence of *E. coli* O157:H7 and feedlot performance. Cattle were randomly assigned to one of two treatments: 1) SRP *E. coli* O157:H7 vaccination or 2) placebo control. Randomization was conducted by alternately assigning five cattle to a treatment until cattle within purchase group were assigned (two treatments; 10 replications; 20 pens). Cattle were fed a typical High Plains diet (74.5% DM; 58 % corn, 30 % corn gluten feed, 6.5% alfalfa hay, and supplement). Cattle were vaccinated with the assigned treatment on d-0 and d-21. Rectal fecal samples were collected on d-0. Pen floor samples were collected on d-21, d-35, and d-70. Simulated slaughter was performed on d-85 to evaluate prevalence of *E. coli* O157:H7 in rectal fecal samples, rectoanal mucosal swab samples, and hide swab samples. All samples were transported to the laboratory for *E. coli* O157:H7 isolation. Cattle were individually weighed on d-0, d-21, and d-85. Pen feed delivery was recorded daily and orts were removed and weighed. No vaccine by day interaction was observed. Cattle vaccinated with SRP had a reduced (P = .04) fecal shedding of *E. coli* O157 by 54% relative to those receiving placebo. Cattle vaccinated with SRP had a lower prevalence of *E. coli* O157:H7 in their feces (P = .01) and on their hides (P = .06) than those vaccinated with placebo at simulated slaughter. Vaccinating cattle with SRP *E. coli* O157:H7 had no effect (P > .05) on ADG or DMI. The *E. coli* O157:H7 SRP vaccine reduced prevalence of *E. coli* O157:H7 in feedlot cattle and could be used as a possible strategy to reduce the risk of foodborne illness associated with beef.

Key Words: Vaccine, *E. coli* O157:H7, Feedlot Cattle

252 Effects of distiller's grain on fecal prevalence and in vitro growth of *E. coli* O157. M. E. Jacob*, J. T. Fox, J. S. Drouillard, and T. G. Nagaraja, *Kansas State University*, *Manhattan*.

The objective was to determine effects of feeding distiller's grains (DG) on prevalence of *E. coli* O157 in feedlot cattle. Cattle (n = 379) were allocated to one of three treatments: steam-flaked corn (SFC) with 5% corn silage and 25% dried DG (DDG), SFC with 15% corn silage and 25% DDG, or SFC with 15% corn silage and no DDG. Cattle were fed in pens containing 14 to 16 animals, with 8 pens (replications) per treatment. From each pen, 10 pen-floor fecal samples were collected weekly for 12 wk and were cultured for *E. coli* O157. Cattle fed DDG with 5 or 15% corn silage had a higher (P < 0.05) prevalence of *E. coli* O157 than those fed no DDG. No differences (P > 0.05) in prevalence were observed between cattle fed DDG and either 5 or 15% corn silage. A second study was conducted to assess effects of DDG on growth of *E. coli* O157 in vitro (i.e., fermentations with ruminal or fecal microbial inoculum). Rumen fluid and feces were collected from two ruminally-cannulated steers fed high-grain diets containing 0 or 25% DDG. Fermentations (in duplicates) with 0, 0.5, 1, or 2 g of DDG (substrate) were repeated on 2 d. Each fermentation was inoculated with naladixic acid resistant (*Nal*^{R}) *E. coli* O157 and samples were removed at 0, 6, 12, and 24 h to determine concentrations of *Nal*^{R} *E. coli* O157. At 24 h, fecal fermentations with 2 g DDG had higher (P < 0.05) concentrations of *Nal*^{R} *E. coli* O157 than 0 , 0.5, or 1 g DDG. In fermentations with ruminal inoculum, the 24 h incubations with 0.5 g DDG had a higher (P < 0.05) concentration of *Nal*^{R} *E. coli* O157 than 0 , 1, or 2 g DDG. Fermentations with 0 g DDG had higher (P < 0.05) *Nal*^{R} *E. coli* O157 concentrations than 1 or 2 g DDG. The source of ruminal or fecal microbial inoculum (DDG or no DDG) had no effect on concentrations of *E. coli* O157. The results suggested inclusion of DDG in high-grain diets to have the potential to increase fecal shedding of *E. coli* O157.

Key Words: *E. coli* O157, Distiller's Grains, Cattle

253 Growth response of *Salmonella enterica* Typhimurium in co-culture with ruminal bacterium *Streptococcus bovis* is affected by time of inoculation and carbohydrate substrate. P. Herrera* and S. Ricke, *Center for Food Safety and Microbiology, IFSE, University of Arkansas*, *Fayetteville, AR*.

The purpose of this study was to characterize growth of *Salmonella enterica* Typhimurium (ST) in the presence of the ruminal bacteria *Streptococcus bovis* (SB) under different incubation conditions. The growth of SB and ST plateaued after 9 h when incubated independently at 37°C. When SB and ST were co-cultured, 15.8 ± .02% growth inhibition was observed for ST. When inoculation of ST in the co-culture was delayed, ST growth was inhibited by 41.5 ± .02% for ST inoculation at 6 h and by 27.8 ± .06 % for ST inoculation at 12 h. A decrease in the pH of SB culture media from 7.1 to 6.2 was observed at 6 h of growth. To determine the effects of alternate carbon substrates, sugars were added to the media (1 mL of 180 mg/mL w/v solution to 9 mL media). Glucose produced a marked decrease in pH of SB culture media (7.0 vs 4.9 over 6 h) whereas fructooligosaccharide (FOS) did not (6.8 vs 6.0 after 6 h) when compared to SB cultures in an unmodified media. Addition of glucose to the culture media resulted in a 2.5 fold increase in SB when compared with SB cultures grown in an unmodified media or media amended with FOS. Supplementing the media with either sugar enhanced growth of ST. Cultures of ST supplemented with glucose reached the upper limit of detection of our assay within 4 h. When both bacteria were inoculated simultaneously in media containing either sugar, no ST growth inhibition was observed. No growth inhibition of ST in glucose-supplemented media was seen when a 6 h elapsed between the initial SB inoculation and subsequent inoculation with ST. However in similar trials with FOS amended media, a 68.1 ± 0.01% inhibition in ST growth occurred. These findings

suggest that carbon substrate and time of inoculation influence ST growth in the presence of actively growing SB.

Key Words: *Salmonella*, *Streptococcus bovis*, Bacterial Growth

254 Effects of acid marinades on *Listeria monocytogenes*, shelf life, meat quality, and consumer acceptability of beef frankfurters. J. W. J. Bowers* and S. R. McKee, *Auburn University*, *Auburn, AL*.

Listeria monocytogenes (LM) is estimated to cause over 2,500 cases of illness and 500 deaths in the U.S. annually. To control LM, acid marinades are being used in formulation of ready-to-eat meat products as *Listeria* inhibitors. Sodium diacetate, sodium/potassium lactate and sodium citrate are approved inhibitors that can be used alone or in combination to prevent growth of LM, but their effects on product quality need to be determined. The objective was to determine effects of marinade ingredients including: No inhibitors (NI), sodium lactate at 2% (SL); potassium lactate at 2% (PL); sodium citrate at 0.75% (SC); sodium lactate at 2% with sodium diacetate at 0.25% (SLSD) on growth of LM in beef frankfurters stored at 4°C and 15°C. Beef frankfurters (60 per treatment) were inoculated (10^6 cfu/mL) with a streptomycin-resistant (1,500 µg/mL) strain of LM and were sampled once per week for LM growth. Additional beef frankfurters prepared with inhibitors (60 per treatment) were used for shelf life determination (up to 12 wk; stored at 4°C and 15°C) and for meat quality measurements. Shelf life was evaluated each week using a consumer sensory panel combined with microbial analyses. Objective meat quality parameters measured included pH, total moisture, and springiness. At 15°C, all treatments except SLSD reached spoilage. All treatments stored at 4°C resisted spoilage until wk 3; however, the SLSD destroyed product quality. Microbial analyses of inoculated beef frankfurters suggested that all products containing inhibitors delayed growth of LM when compared with the control (NI) until wk 3. Inoculated treatments stored at 15°C were uncountable at wk 3 due to overgrowth of molds. Overall, LM growth was delayed with inclusion of inhibitors but this benefit was not observed with higher storage temperatures (15°C). Additionally, sodium diacetate at 0.25% may decrease protein functionality and consumer acceptability of beef frankfurters, but it restricts growth of spoilage bacteria.

Key Words: *Listeria monocytogenes*, Acid Marinades, Beef Frankfurters

255 Implementation of a dual electronic identification and molecular markers system for tracing pigs. M. Hernández-Jover[1], G. Caja*[1], J. J. Ghirardi[1], J. Reixach[2], and A. Sánchez[1], [1]*Universitat Autònoma de Barcelona*, *Bellaterra, Spain*, [2]*Selección Batallé*, *Riudarenes, Girona, Spain*.

A total of 2,108 Duroc male piglets were used to validate a dual traceability system based on the use of electronic identification (e-ID) and on the use of DNA fingerprinting by analysis of a specific set of porcine microsatellites (n = 12). Piglets were identified (9 ± 3 d of age) using 32 mm half-duplex injectable transponders (Rumitag, Barcelona, Spain) injected intraperitoneally (IP). A single-shot injector with interchangeable needles (23 × 4.6 mm) was used. Needles were immersed in iodine solution before each injection, and injection area was disinfected by spraying an antibiotic. Piglets were also ear tagged and biopsied at the moment of IP injection, using two types of biopsying ear tags (E1 [n = 979; Biopsytec, Rheinbach, Germany] and E2 [n = 1,129; TypiFix, IDnostic, Switzerland]). Grow-fattening up to 120 kg BW (7 mo of age) was conducted under intensive conditions. Harvesting was done in a high throughput abattoir (500 pigs/h) and pig e-ID was automatically transferred to carcasses, using a high frequency inlay label (45 × 76 mm; Tiris, Almelo, Holland). Samples were taken from carcasses using biopsy tubes (Biopsytec) and stored frozen until DNA analysis. On-farm losses of IP transponders were 0.6%. Most of them (58.3%) occurred during wk 1 after injection. Ear tag losses were 0.7 and 0.4% for E1 and E2, respectively. On-farm traceability results were 99.3, 99.6, and 99.4% for E1, E2, and IP, respectively. Ear tag losses during harvesting (E1 [35.3%] and E2 [37.6%]) indicated their use for traceability is unsuitable. No losses of IP were reported during harvesting. Automatic transfer of e-ID to carcasses was 95.1% successful. Final pig traceability from birth to slaughter was 94.5% for IP transponders. A total of 100 pairs of samples (5%) were analyzed for DNA auditing. Results did not match in four pairs of samples, showing 96% traceability. In conclusion, the use of intraperitoneally injected transponders improved pig traceability. Nevertheless, automatic transfer of e-ID to carcasses needs to be improved in order to provide a more reliable technique for the swine industry.

Key Words: Traceability, Transponder, Fingerprinting

256 Split marketing: A risk factor for *Salmonella* in market pigs. M. H. Rostagno*[1], H. S. Hurd[2], and J. D. McKean[2], [1]*USDA, ARS, Livestock Behavior Research Unit*, *West Lafayette, IN*, [2]*Iowa State University*, *Ames*.

This study was designed to determine if split marketing affects *Salmonella* prevalence in market pigs. This was achieved by comparing *Salmonella* prevalence in the first group of pigs selected for slaughter (first pull) versus the last group of pigs selected for slaughter (close out) from typical commercial finishing barns containing approximately 1,000 animals. Nine paired observations were included in the study. Each paired sampling consisted in matched groups of pigs from the same barn as the first pull and the close out, with a 4-wk interval between groups. From each group, individual fecal (n = 45) and meat samples (n = 50) were collected, on-farm and at slaughter, respectively. In the laboratory, fecal samples were selectively enriched, and analyzed for the presence of *Salmonella* by a direct (antigen-capture) ELISA. Meat samples were kept frozen until processed, and then thawed, when the resulting liquid (meat juice) was collected and analyzed for the presence of antibodies against *Salmonella* by an indirect ELISA. All lots of finishing pigs studied were positive for *Salmonella*, based on sampling from both, first pull and close out. In seven of the nine lots studied (77.8%), an increase ($P < 0.05$) in *Salmonella* prevalence was observed based on both bacteriological and serological analysis. Overall, there was 9.3% increase ($P < 0.05$) in bacteriological prevalence and 25.1% increase ($P < 0.05$) in serological prevalence from first pull to close out market groups. The results showed that a significant increase of *Salmonella* prevalence to occur between the first and the last group of pigs from a finishing barn shipped to slaughter. Thus, split marketing affects prevalence of *Salmonella* in market pigs with close out market groups constituting a higher risk for *Salmonella* contamination of pork products.

Key Words: Swine, *Salmonella*, Food safety

257 Are there high and low *Salmonella* prevalence farms? M. H. Rostagno*[1], H. S. Hurd[2], and J. D. McKean[2], [1]*USDA, ARS, Livestock Behavior Research Unit*, *West Lafayette, IN*, [2]*Iowa State University*, *Ames*.

The objective of this study was to evaluate the stability of *Salmonella* prevalence in cohorts of finishing pig lots. Six finishing production sites were visited six times each. At each visit, 30 individual fecal samples were randomly collected directly from the rectum. At slaughter, 50 individual meat samples were randomly collected per lot. Fecal samples were selectively enriched, and analyzed for the presence of *Salmonella*. Meat samples were frozen, thawed, and the resulting liquid (meat juice) was analyzed for the presence of antibodies against *Salmonella*. All finishing production sites were positive for *Salmonella* in at least two fecal and four meat samplings. The overall *Salmonella* bacteriological prevalence was 12.9% (95% C.I. 8.0 to 17.8%), whereas the serological prevalence was 35.4% (95% C.I. 24.5 to 46.4%; $P < 0.05$). A wide variation in *Salmonella* prevalence (bacteriological and serological) of different finishing pig lots within individual production sites was found. The wide variation found did not allow the categorization of the sites (statistically) as high or low prevalence systems. Possible reasons for the variation found within production sites include: 1) occurrence of intermittent shedding and clusters, and 2) evolution and resolution of *Salmonella* infection epidemics. The results showed both, bacteriological and serological estimates of *Salmonella* prevalence in swine production systems to be inconsistent among cohorts over time. The results suggested that reporting high or low prevalence of *Salmonella* in swine farms is a matter of timing.

Key Words: Swine, *Salmonella*, Food safety

Forages and Pastures - Livestock and Poultry: Tropical Forages: Management and Environmental Issues Affecting Use Efficiency

258 Programming grazing, irrigation and fertilization cycles based on physiological and environmental data for tropical grasses. J. Rodriguez-Absi*[1] and E. Gutierrez-Ornelas[2], [1]*Raesa Mexico*, *Queretaro, Queretaro, Mexico*, [2]*Universidad Autonova de Nuevo Leon*, *Marin, Nuevo Leon, Mexico*.

An integrated system for intensive grazing management was developed using "Agroclimatic clocks" which are calculated from environmental data (mean, minimum and maximum monthly temperatures, and photoperiod) and physiological characteristics (upper and lower developmental temperature threshold for C-4 grasses). The system makes use of three types of "Clocks": a) Plant Development Clock (PDC) calculated from growing degree days b) Plant Growth Clock (PGC) calculated from optimum day and night temperatures for corn plant growth and c) Reference Evapotranspiration Clock (RETC). Actual field growing studies show that a specific corn variety required, depending on the planting date, from 55 to 120 calendar days to reach the kernel milk stage (silage making stage); however, when using the PDC the angular thermal time required for the plant to reach the same stage was 74°C regardless of planting date (angular thermal time is directly proportional to degree days). However PGC, is closely related with the quality of the daily heat received by the plant, (i.e. number of optimal growth days which occur during the plant cycle), that explains why yields are 1.3 to 1.4 times higher for the fall/winter than for the spring/summer growing seasons. Planting date for maximum yield can be established using PDC and PGC. Irrigation program requires also the RETC, FAO crop growth coefficients and soil textural analysis. Fertilization program requires soil fertility analysis and nutrient removal per unit yield. A year round rotational grazing system for perennial grasses can be set by gathering information of at least one growing and resting cycle, including data on stocking rate, forage yield and grass recovery period (50% forage removal). The system allows that grazing begins when the amount of nutrients in forage is maximum. An example of 11 grazing-fertigation cycles marked in the PDC clock for Bermuda grass in Culiacan is presented. Specific "Agroclimatic clocks" can be used for designing an efficient management plan for increase forage yield and quality improvements in harvesting or grazing systems.

Key Words: Growing Degree Days, Bermudagrass, Rotational Grazing

259 Agroforestry livestock feeding systems in tropical America. T. Clavero*[1] and J. Iglesias[2], [1]*Facultad de Agronomia, Universidad del Zulia*, *Maracaibo, Zulia, Venezuela*, [2]*Estacion Experimental Indio Hatuey*, *Matanzas, Cuba*.

Livestock production has been questioned for a long time because its association with deforestation, subsequent environmental degradation and a decline in productivity. Distinct patterns of deforestation are found within and between countries but most of these forests are converted to unsustainable pastures. Recently, agroforestry systems for sustainable animal production have been developed. Trees and shrubs have long been considered as important sources of nutrition for grazing animals for both the quantity and quality of pastures. Among the diverse types of agroforestry systems under study, protein banks and multiple association of tree/grass systems have contributed much to the development of sustainable dairy and meat production and could be considered as systems that can be extended to farmers. There is a diverse literature on the effects of fodder trees on the productivity of cattle, sheep and goats. The main results obtained are: average daily LW gain of 20-26% higher with browsing fodder trees than animals on only grass systems in young bulls for fattering, daily milk production of 7-10 kg/cow without supplementation with 60-65% more milk/cow, milk productivity (l/ha/year) for the associated tree/grass system 75% more than the traditional grass system, daily live weight gains between 400-525 g in growing replacement heifers which allows a live weight for reproduction of 290-300 kg, growing goats with daily live weight gain of 56% more than grass systems and daily LW gain between 85-100 g in sheep with minimal use of external inputs to the systems. The renovation and introduction of appropriate pastures, adapted to local edaphoclimatic conditions, together with the strategic incorporation of tree plants and shrubs in the grazing areas, seems to be a technological alternative that would contribute to improved livestock production diminish the impact of the ecosystems where they are developed. This could constitute an economically viable solution that does not produce environmental damages and is socially accepted and whose short term benefits would be observed in a sustained increment of the animal production.

Key Words: Agroforestry, Animal Production

260 Use of limpograss (*Hemarthria altissima*) in cow-calf grazing systems in southern Florida. J. D. Arthington*, *University of Florida-IFAS, Range Cattle Research and Education Center*, *Ona*.

Over 70% of Florida's 1 million beef cows reside in the state's peninsular region. Forages capable of providing adequate DM yield in the winter are a limitation to beef production systems in this region. Limpograss (*Hemarthria altissima*) possesses superior winter yield compared to other warm season perennial grasses. First extensively evaluated in 1974, 'Floralta' limpograss is the most widely utilized of the available limpograss varieties in southern Florida. This tropical grass originates from the Limpopo River in the Republic of South Africa. Floralta is a stoloniferous perennial tropical grass that was specifically selected for persistence under grazing conditions. In southern Florida, Floralta limpograss can be expected to produce as much as 40% of its annual growth in the winter months compared to only 10% for bahiagrass (Paspalum notatum), the predominate pasture forage specie in Florida. Another distinct characteristic of Floralta is the ability to maintain appreciable digestibility at later stages of maturity, suggesting potential as a stockpiled forage crop. In one 3-yr study, fall-calving cows assigned to a bahiagrass/limpograss rotational grazing system produced calves of equal weaning weight compared to cows grazing winter bahiagrass. In that study, 0.30 ha of stockpiled limpograss was equivalent to approximately 635 kg of supplemental winter. No differences in cow pregnancy rate were observed among grazing systems. Another distinct characteristic of limpograss is its relatively low crude protein content. Research investigating the performance of growing cattle grazing limpograss suggests that growth is not enhanced by protein supplementation until after the first frost of the season. After this time, protein-supplemented heifers realize a significant improvement in BW gain compared to heifers receiving no supplemental protein. Current research in southern Florida suggests that grazing strategies incorporating stockpiled limpograss could be an effective alternative to winter hay feeding. In addition, growing cattle grazing limpograss pastures may benefit from the provision of supplemental protein, especially after a killing frost.

Key Words: Limpograss, Grazing, Cow

261 Managing tropical forages: production, environmental benefits and risks. B. C. Pengelly* and J. G. McIvor, *Agricultural Landscapes, CSIRO Sustainable Ecosystems*, *St Lucia, Qld, Australia*.

Tropical forages have been used in farming systems of the developed and developing world for several decades. Grasses such as *Panicum* spp. and *Pennisetum* spp. have been cultivated for over a century but in the past 50 years there has been a greater focus on legumes such as *Stylosanthes* and *Vigna* spp. In all, over 150 tropical grass and legume species have been identified as being of value in the wide range of tropical and subtropical farming systems. The aims of much of the tropical forage research and cultivar development has been to increase animal production by identifying higher yielding species with better forage quality. The benefits of these species have been improved nutrition of animals and subsequently greater production of meat, milk and wool as well as better reproduction. The production downsides of this pasture use have been high costs, low reliability and poor persistence in some situations. The last 20 years has seen more attention given to environmental aspects of the use of these species. Environmental benefits from such use include nitrogen fixation and raised availability of nitrogen to other species, improved soil carbon levels, greater water use, and biodiversity benefits when compared to cropping systems. However the use of tropical forages has also been associated with a range of environmental disadvantages such as loss of native biodiversity, weed potential, enhanced nitrogen causing changes in species composition, and soil acidification. Overall, there have been large production benefits and some environmental gains from the development and adoption of tropical forages but these have come at a cost. The continuing challenge is in balancing the benefits and costs of their use through the better selection of appropriate species and application of appropriate management. Science has a role in both aspects.

Horse Species: Recent Advances in Understanding Metabolic Disorders in Horses

262 The impact of variability in pasture forages on horse metabolism. B. McIntosh*[1,2], D. Kronfeld[1], R. Geor[1], W. Staniar[1], P. Harris[3], and D. Ward[4], [1]*Virginia Polytechnic Institute and State University*, *Blacksburg*, [2]*Blue Seal Feeds Inc.*, *Londonderry, NH*, [3]*WALTHAM Centre for Pet Nutrition*, *Melton Mowbray, United Kingdom*, [4]*Rutgers University*, *Bridgeton, NJ*.

Nonstructural carbohydrates (NSC), which includes sugars, starches and fructans in pasture forages undergo circadian and seasonal variation which have direct effects on metabolism in grazing horses. Increased intake of NSC is implicated in the development of digestive and metabolic disorders, such as laminitis. A series of 36 h studies in Virginia examined circadian and seasonal variability in forage NSC content and circulating plasma glucose and insulin in grazing horses (n=10) compared to control horses fed timothy/alfalfa hay (n=4). The unequal group size was accounted for in the statistical analyses which included two-way repeated measures ANOVA with post tests, linear regression, and correlations. We found that circadian and seasonal patterns in forage NSC content in a 5-ha mixed grass/legume pasture were associated with environmental conditions, and NSC was in turn associated with plasma insulin and glucose in the grazing horses. Forage NSC content was highest in April (20.3±0.4 %DM) ($P < 0.001$) and was attributed mostly to sugars (18.9±0.4 %DM), including glucose, sucrose and fructose. Circadian patterns in forage NSC were evident in April, May, and August, with the most distinct pattern found in April with peaks in the afternoon (22.2±0.3 %DM) and nadirs in the morning (17.1±0.3 %DM). Plasma insulin was higher in grazing horses than control horses in April (54.6±9.9μIU/mL) and May (20.8±3.4μIU/mL) ($P < 0.05$). In grazing horses, plasma insulin was significantly correlated with forage NSC and sugar in April, May, and January. In grazing horses, plasma glucose was higher in April than all months except for May, and plasma glucose was higher in grazing horses compared to controls in April. These studies identified a potential link between forage NSC content and alterations in glucose and insulin characteristics that may increase risk of laminitis via exacerbation of insulin resistance. Management strategies to decrease intakes of pasture NSC by horses at risk of developing metabolic disorders are needed.

Key Words: Horse, Forage, Metabolism

263 Advances in diagnosis and management of equine polysaccharide storage myopathy (PSSM). M. E. McCue*, S. J. Valberg, and J. R. Mickelson, *University of Minnesota*, *St. Paul*.

PSSM is a debilitating muscle disease in diverse breeds of horses. Clinical signs range from exertional rhabdomyolysis in Quarter Horses, muscle atrophy and progressive weakness in Draft breeds to muscle soreness and gait abnormalities in Warmbloods. PSSM affects 10% of Quarter Horses and 36% of Belgian Draft horses and an unknown number of Warmbloods in both Europe and North America. The gold standard for diagnosis of PSSM is the presence of periodic acid Schiffã™ (PAS) positive inclusions in type 2A and type 2B muscle fibers which are resistant to amylase digestion. In addition, PSSM is characterized by 1.5-4 X normal glycogen concentrations in skeletal muscle. No defect in glycogenolysis or glycolysis have been identified in PSSM horses. Rather glycogen accumulation appears to be related to enhanced glycogen synthesis. In Quarter Horses enhanced insulin sensitivity is also reported. Through a limited breeding trial and a genetic association analysis of an extensive number of clinical cases, we recently identified an autosomal dominant genetic mutation that is highly associated with PSSM in both Quarter Horses and Belgian Draft horses. This mutation accounts for 80 and 89% of PSSM cases in each breed respectively. We anticipate a genetic test will be available for PSSM within the next year.

Dietary management of PSSM involves decreasing dietary starch and provision of a fat supplement as an alternative energy substrate. This stabilizes blood glucose, increases serum free fatty acids and lowers insulin concentrations. Fat supplementation should be used judiciously in overweight horses. Muscle stiffness and exertional rhabdomyolysis can be eliminated in most horses if this diet is combined with daily exercise. Quarter Horses have a low skeletal muscle oxidative capacity and low intramuscular lipid stores. Gradual training is essential to improve muscle function likely through increased glycogen metabolism, increased oxidative capacity to utilize fat and improved substrate flux.

Key Words: Genetic, Glycogen, Muscle

264 Management of obesity and insulin resistance in horses. R. J. Geor*, R. A. Carter, and K. H. Treiber, *Virginia Polytechnic Institute and State University*, *Middleburg, VA*.

Although epidemiological data are scant, it has been suggested that the prevalence of obesity in horse (and pony) populations is on the rise. There is no universal definition of obesity in equids but according to the body condition scoring system (BCS) developed by Henneke, horses or ponies with a BCS of 8 (fat) or 9 (extremely fat) can be defined as obese, while animals with a BCS of 7 might be considered overweight. Insulin resistance (IR) is associated with obesity in horses and this disturbance to metabolic regulation may underlie susceptibility to laminitis, particularly the pasture-associated form of this disease. In support of this hypothesis, Treiber et al. (2006) recently described a ″pre-laminitic metabolic syndrome″ (PLMS) in otherwise healthy ponies with high (>70%) sensitivity and specificity for identification of animals at increased risk for pasture-associated laminitis. The central features of the PLMS were hyperinsulinemia, IR and generalized and/or regional (e.g. a cresty neck) adiposity. A similar clustering of clinical conditions, referred to as the equine metabolic syndrome (EMS), likely occurs in mature horses. In susceptible horses and ponies, consumption of forage or feed rich in nonstructural carbohydrates (NSC; sugars, fructans, and/or starch) may exacerbate IR and risk of laminitis. The mechanisms linking IR and laminitis are unknown, but might involve impaired glucose delivery to hoof keratinocytes or vascular endothelial dysfunction associated with oxidative stress and/or inflammation. Specific quantitative characterization of IR can be used to identify horses and ponies in need of special measures to avoid laminitis, particularly interventions that target decreased body fat mass and improved insulin sensitivity, including a reduction in dietary energy (calories) and NSC, restricted access to pasture during high-risk periods, and increased physical activity. The administration of levothyroxine sodium may be justified for animals that do not respond to diet and exercise programs alone.

Treiber KH, Kronfeld DS, Hess TM et al. 2006. J Am Vet Med Assoc 228:1538-1545.

Key Words: Horse, Obesity, Insulin resistance

Lactation Biology: Metabolism and Gene Expression in Support of Lactation

265 Characterization of the utilization of trans octadecenoic acids in lactating dairy cows. C. Tyburczy*[1], A. L. Lock[1], D. A. Dwyer[1], F. Destaillants[2], Z. Mouloungui[3], L. Candy[3], and D. E. Bauman[1], [1]*Cornell University*, *Ithaca, NY*, [2]*Nestle Research Center*, *Lausanne, Switzerland*, [3]*Laboratoire de Chimie Agro-Industrielle*, *Toulouse, France*.

The biological activity of individual octadecenoic acids may be dependent on the location and orientation of the double bond. Therefore, our objective was to examine the affect of elaidic acid (trans-9 18:1; EA) and vaccenic acid (trans-11 18:1; VA) in relation to oleic acid (cis-9 18:1; OA) during lactation. Three mid-lactation Holstein cows were used in a 3x3 Latin square design, and treatments (>82% purity) involved abomasal infusion of 1) EA (41.7 g/d), 2) VA (41.4 g/d) and 3) OA (45.5 g/d). Treatment periods were 4 d, separated by a 7 d wash-out interval. Milk yield (24.2 ± 2.2 kg/d; mean ± SD) and yield of milk components were not affected by treatment. Incorporation of infused isomers into milk fat triglycerides (TG) plateaued by d 3 and transfer efficiency averaged 59.1 ± 0.1%, 54.2 ± 0.1% and 54.6 ± 0.3% for EA, VA and OA, respectively. For the VA treatment, milk fat content of cis-9, trans-11 conjugated linoleic acid (CLA) more than doubled and the ratio of VA to CLA did not change, consistent with mammary conversion of VA to CLA by delta-9 desaturase. Total lipid concentration of plasma lipid classes averaged 209.9 ± 10.5 mg/dl, 161.4 ± 15.4 mg/dl, 14.5 ± 2.0 mg/dl and 2.4 ± 0.5 mg/dl for phospholipids (PL), cholesterol esters (CE), TG and free fatty acids (FFA), respectively. Similar values for the proportion of fatty acids provided by each plasma lipid class were 60.3 ± 2.2%, 32.1 ± 1.8%, 6.4 ± 0.8% and 1.2 ± 0.3%. Infusion of EA, VA and OA increased their specific content in plasma PL, TG and FFA, but for VA the relative increase was much greater for plasma TG and FFA. Overall, data demonstrate that biological differences exist among individual octadecenoic acids in lactating dairy cows.

Key Words: Milk Fat, Trans Fatty Acids, Lactation

266 Expression of lipogenic genes in adipose tissue increases during milk fat depression induced by treatment with trans-10, cis-12 conjugated linoleic acid (CLA). K. J. Harvatine*, D. A. Dwyer, and D. E. Bauman, *Cornell University*, *Ithaca, NY*.

Trans-10, cis-12 CLA decreases milk fat synthesis through transcriptional down-regulation of genes involved in mammary fatty acid synthesis, transport and esterification. Intake is not decreased during CLA-induced milk fat depression, resulting in a calculated increase in energy balance. To investigate energy partitioning during milk fat depression, adipose tissue biopsies were taken from four cows arranged in a switchback design. Treatments were control and 4 day abomasal infusion of trans-10, cis-12 CLA (7.5 g/d). CLA decreased milk fat yield by 38% and milk fat content by 34%, but yields of milk and other milk components were unchanged. Adipose tissue was biopsied from adjacent to the tail head, and expression of lipogenic enzymes and transcription factors regulating lipogenesis was determined by Real-Time PCR. Expression of lipoprotein lipase, fatty acid synthase and stearoyl-CoA desaturase was increased more than one fold over control ($P < 0.002$). The lipogenic regulatory proteins sterol-response element binding protein 1 (SREBP1) and throid hormone responsive spot 14 were increased, and leptin and PPARgamma tended to increase. Thus, a CLA dose resulting in near maximal inhibition of mammary lipogenesis resulted in increased expression of lipogenic-related genes in adipose tissue. Overall, results are consistent with energy spared from the reduction in milk fat synthesis being partitioned towards adipose tissue fat stores during short-term milk fat depression.

Key Words: Milk Fat Depression, Fat Synthesis, Adipose Tissue

267 The relationship between trans-10 18:1 and milk fat yield in cows fed high oleic acid or high linoleic acid plant oil supplements. T. Hinrichsen[1], A. L. Lock*[2], and D. E. Bauman[2], [1]*Royal Veterinary & Agricultural University*, *Denmark*, [2]*Cornell University*, *Ithaca, NY*.

Trans-10 18:1 (t10) has been proposed to affect milk fat synthesis because its milk fat content is associated with diet-induced milk fat depression (MFD). We summarized data from 35 publications (109 treatments) and found an inverse curvilinear relationship between milk fat content of t10 and milk fat percent ($R2 = 0.54$). However, t10 may be a marker for the altered rumen biohydrogenation (BH) that occurs with MFD rather than having a direct inhibitory effect per se. In vitro studies have shown that the BH of oleic acid results in formation of a range of trans-18:1 fatty acids (TFA), whereas BH of linoleic acid produces both conjugated 18:2 and TFA. Therefore, we used plant oils enriched in either oleic or linoleic acid to examine potential effects of TFA on MFD. Cows ($n = 30$) were fed a basal TMR diet for 3 wk (Period 1). In Periods 2 and 3 (14 and 11 d, respectively) cows were divided into 3 groups: control group (C) that continued on basal diet, high-oleic (82%) sunflower oil supplemented group (O) and high-linoleic (75%) safflower oil supplemented group (L). Oils were added at 2.5 and 3.5 % of DM in Periods 2 and 3, respectively. There were no treatment differences for yield of milk, milk protein or milk lactose ($P > 0.05$). Milk fat yield was reduced by 14% ($P < 0.05$) and 34% ($P < 0.001$) in Periods 2 and 3, respectively, for treatment L compared to C; treatment O did not differ from C ($P > 0.05$). Milk fat t10 (g/100 g FA) increased 4-fold ($P < 0.01$) and 2-fold ($P = 0.17$) for L and O, respectively, in Period 2. Similar increases for Period 3 were 11-fold ($P < 0.001$) and 4-fold ($P < 0.01$) for L and O. A 4-fold increase in t10 correlated with MFD when cows received the linoleic acid supplement, but no MFD occurred with a similar increase and milk concentration of t10 induced by oleic acid supplement. Thus, the present study offers no support for t10 as a cause of MFD and highlights the limitation in concluding cause-effect relationships based on correlations between specific milk fatty acids and MFD.

Key Words: Milk Fat, Trans Fatty Acids, Lactation

268 In vivo treatment with xanthosine expands the mammary stem cell population. A. V. Capuco*[1], C. M. Evock-Clover[1], D. L. Wood[1], and A. Minuti[2], [1]*Bovine Functional Genomics Laboratory, USDA-ARS*, *Beltsville, MD*, [2]*Institute of Zootechnics, Catholic University*, *Piacenza, Italy*.

Mammary stem cells provide for growth and maintenance of the mammary gland and are therefore likely targets for means to improve the productivity and efficiency of dairy animals. Xanthosine treatment has been shown to promote expansion of hepatic stem cells in vitro. The objective of this study was to determine if in vivo treatment with xanthosine can increase the mammary stem cell population. Xanthosine was infused into the right mammary glands of four Holstein calves (3 mo old) for 5 consecutive days. The right rear quarter received a supplemental injection of xanthosine directly into the mammary parenchyma. Immediately after each xanthosine treatment, calves were injected intravenously with 5-bromo-2-deoxyuridine (BrdU). Forty days after the final treatment, mammary tissue was obtained at slaughter. BrdU-label retaining epithelial cells (LREC) were detected immunohistochemically and quantified. We and others have employed the retention of BrdU as a method for labeling putative bovine mammary stem cells. Infusion of xanthosine into the bovine mammary gland significantly increased the number of LREC in treated quarters compared to contralateral control quarters ($P = 0.06$). LREC averaged 0.4% of epithelial cells in control and 0.84% in xanthosine-treated quarters. Data indicate that in vivo treatment with xanthosine can be used to increase the number of mammary stem cells. This is the first demonstration of an in vivo treatment to increase the endogenous population of adult mammary stem cells in any species. Utility of this treatment for biomedical research and for dairy management is of considerable interest.

Key Words: Progenitor Cells, Lactation, Proliferation

269 Prepubertal nutrition effects on bovine mammary parenchyma and fat pad gene expression profiles. P. Piantoni*[1], D. Graugnard[1], K. M. Daniels[2], R. E. Everts[1], S. L. Rodriguez-Zas[1], H. A. Lewin[1], R. M. Akers[2], and J. J. Loor[1], [1]*University of Illinois*, *Urbana*, [2]*Virginia Polytechnic Institute and State University*, *Blacksburg*.

Nutrition prior to puberty appears to differentially affect bovine mammary parenchyma and fat pad development. Objectives were to evaluate gene expression profiles in parenchyma and fat pad due to enhanced nutrient intake to achieve widely-different rates of gain during the isometric growth phase in the first 63 d of life in Holstein heifers. Tissues from calves fed ($n = 6$/milk replacer diet) a control (20:20, protein:fat, fed at 450 g/d), high protein low fat (28:20, HPLF, fed at 970 g/d), HP high fat (28:28, HPHF, fed at 970 g/d), or 1.5X HPHF (HPHF+, fed at 1460 g/d) diet were used for RNA extraction. Calf starter (20% CP) was available ad libitum. A 13,257 bovine

oligonucleotide (70-mers) array and qPCR were used for gene expression profiling. Annotation was based on similarity searches using BLASTN against human, mouse and bovine RefSeq, human, mouse, and bovine UniGene, and bovine TIGR. Cy3- and Cy5-labelled cDNA from mammary parenchyma or fat pad and a reference standard were used for hybridizations (80 arrays). ANOVA (FDR-adjusted $P \leq 0.10$) identified 5,585, 203, and 20 differentially expressed genes due to tissue type, diet, and diet x tissue interaction, respectively. Among upregulated genes in HFHP+ vs. control or HFHP, regardless of tissue, Ingenuity Pathway Analysis identified cell assembly/organization, cell growth/proliferation, and cell death as modified families of related genes. However, analysis of downregulated genes between HFHP+ and HFHP showed major impacts in gene expression regulation, small molecule biochemistry, and immune response. Further, histidine metabolism, fatty acid metabolism, Val/Leu/Ile degradation, Arg/Pro metabolism, and IL2 signaling were the most significant canonical pathways among downregulated genes. We conclude that the mammary parenchyma and fat pad transcriptomes are impacted by nutrition during the first 2 mo of life. Genomic adaptations could at least in part explain tissue growth responses to enhanced nutrient intake.

Key Words: Calf, Genomics, Mammary Gland

270 Mammary gland expression of cell cyle, apoptosis, and immune response genes accompany progression through a prolonged lactation cycle. D. L. Hadsell*, D. Torres, and M. S. Bray, *Baylor College of Medicine*, *Houston TX*.

In the mouse mammary gland, the prolonged lactation cycle is a biphasic developmental process that is characterized by a wave of proliferation during the early postpartum period followed by decreased proliferation in mid-lactation and elevated apoptosis during prolonged lactation. The goal of this study was to identify the genes regulating secretory cell function and turnover during this cycle. Mammary samples (N=5 mice/time) were collected from mice on days 2, 8, 14, 21, 28, and 35 post-partum. Total RNA from these samples was analyzed using the Sentrix Mouse Ref 6 BeadChip (Ilumina, Inc.). Of the 46,119 genes and ESTs on the array, expression was detected for 17,028. One-way ANOVA identified 1,645 genes that changed ($P<0.05$) with time, and 1,056 genes that changed by at least 2-fold. Expressed genes were clustered into 10 distinct temporal patterns using k-means clustering. The 10 patterns were labeled based on the direction (Down, Flat, or Up) of each sequential change in expression for each of the pairwise comparisons between the 6 adjacent time points. Patterns 1 (DUUFF), 5 (UUFFU), 7 (UUUDU) and 9 (FUUFF) were enriched ($P<0.05$) in genes integral to immune response, defense response, cell motility, and cell death. These genes were low during early lactation and maximally expressed during prolonged lactation. Patterns 2 (DDUFU), 6 (DFUUU), 8 (DFUFU) and 10 (DDUUU) were at their highest expression on day 2 and decreased with time postpartum. These genes regulated primary metabolism, DNA metabolism, cellular protein metabolism, cell cycle, and mitosis. Patterns 3 (FDDFU) and 4 (UFDFU) were associated with metabolism and transport. These genes increased between days 2 and 8, and then decreased through the remainder of the study. These results demonstrate that previously observed changes in mammary cell turnover during the prolonged lactation cycle are supported by concomitant changes in the expression of cell cycle and cell death genes. The results also support the conclusion that the immune system is important to regulating the decline in milk synthesis during prolonged lactation.

Key Words: Mammary, Microarray, Lactation

271 SOCS3 and STAT3 are up-regulated and STAT5 down-regulated during induced involution of the bovine mammary gland. K Singh*, M Prewitz, J Dobson, and K Stelwagen, *AgResearch Ltd, Ruakura Research Centre*, *Hamilton, New Zealand*.

In dairy animals, gradual involution associated with a decline in milk yield occurs following peak lactation. In cows, abrupt termination of milking induces involution of the mammary gland which is characterized by alveolar engorgement, followed by decreased communication between mammary epithelial cells (MEC) and extracellular matrix, as well as cell-cell communication and subsequently increased apoptosis of the secretory MEC. The aim of this study was to investigate the role of STAT5, STAT3 and SOCS3 in the bovine mammary gland during this process, ultimately to understand mechanisms to improve milk production during late lactation. Alveolar tissue was obtained from non-pregnant cows in mid-lactation slaughtered at 0, 6, 12, 18, 24, 36, 72 and 192h (n=6/group) after the last milking. Western blot analysis showed STAT5a and phosphorylated STAT5 levels were decreased 2-fold by 24h post milking ($P<0.01$) and remained down-regulated to 192h by 4.4-fold and 7.7-fold ($P<0.01$), respectively, relative to 6h post milking. STAT3 expression was also down-regulated (2.4-fold, $P<0.05$), but only at 192h relative to 6h after the last milking. However, relative to 12h post milking, the level of STAT3 decreased from 36h onwards ($P<0.05$). In contrast, phosphorylated STAT3 was barely detectable at the early time points and was dramatically up-regulated by 36 and 72h post milking by 39- and 44-fold ($P<0.001$), respectively, and at 192h post milking by 22-fold ($P<0.05$), all relative to 6h. Real-time RT-qPCR analysis showed that SOCS3 mRNA levels were up-regulated by 72h post milking (2.3-fold, $P<0.05$). These results suggest that the up-regulation of SOCS3 and phosphorylated STAT3 and down-regulation of STAT5 play a key role during bovine mammary gland involution.

Key Words: SOCS3, STAT3 and 5, Bovine Mammary Involution

272 MammOmics™: transcript profiling of the mammary gland during the lactation cycle in Holstein cows. M. Bionaz*, S. L. Rodriguez-Zas, R. E. Everts, H. A. Lewin, and J. J. Loor, *University of Illinois*, *Urbana*.

Achieving greater understanding of the genomic adaptations in the mammary gland of high-producing dairy cows during lactation represents a formidable challenge. Our objective was to explore the mammary transcriptome using biopsies from 8 Holstein cows harvested at -30, -15, 1, 15, 30, 60, 120, 240, and 300 d relative to parturition. Milk composition and milk fatty acid profiles also were determined throughout lactation. A 13,257 unique oligonucleotide (70-mers) array was used for transcript profiling. Annotation was based on similarity searches using BLASTN against human, mouse and bovine RefSeq, human, mouse, and bovine UniGene, and bovine TIGR. Cy3- and Cy5-labelled cDNA from mammary tissue and a reference standard were used for hybridizations. ANOVA (false discovery rate-adjusted $P \leq 0.05$) identified 7,055 differentially expressed genes due to physiological state. A total of 701 of these genes had a ≥2-fold change in expression in at least one other time point examined relative to day -30. We verified key microarray results for 38 genes by qPCR. Expression patterns of the 701 genes relative to d -30 were grouped into 2 clusters of upregulated (283) and 4 clusters of downregulated genes (418). Ingenuity Pathway Analysis mapped 3,355 of 7,055 differentially expressed genes. Relative to d -30, network analysis of genes with ≥2-fold expression indicated that some of the most predominant

molecular functions were on d -15 immune response (6 genes), on d 1 (25) through d 60 (48) lipid metabolism and molecular transport, on d 120 (53) cell-to-cell signaling and tissue development, and on d 240 (10) and 300 (7) connective tissue development and function. Twenty-nine of 52 downregulated genes by ≥2-fold on d 60 were associated with cell-to-cell signaling. Similarly, 30 of 49 downregulated genes on d 240 and 300 were associated primarily with molecular transport. Transcriptome analysis highlighted the importance of genes associated with immune function, lipid metabolism, transport, and tissue remodeling during the lactation cycle in the bovine mammary gland.

Key Words: Gene Networks, Microarray, Genomics

273 Photoperiod alters metabolic gene expression in bovine liver potentially through suppressors of cytokine signaling. E. E. Connor*[1], E. D. Thomas[2], and G. E. Dahl[3], [1]*Bovine Functional Genomics Laboratory, USDA-ARS*, *Beltsville, MD*, [2]*Department of Animal and Avian Sciences, University of Maryland*, *College Park*, [3]*Department of Animal Sciences, University of Florida*, *Gainesville*.

Previous research has demonstrated effects of day length (photoperiod) on multiple physiological processes in cattle including reproduction, lactation, immune function, growth and carcass composition. Many of these effects are mediated by changes in prolactin (PRL) and PRL signaling. Recent research has shown a role of PRL-responsive suppressors of cytokine signaling (SOCS) in fatty liver and metabolic syndrome in rodents. Thus, to determine whether photoperiod manipulation could influence hepatic lipid metabolism in ruminants, we investigated the effects of short-day (8 h light:16 h dark; SD) and long-day (16 h light:8 h dark; LD) photoperiod exposure on hepatic *SOCS* and metabolic gene expression in Holstein steer calves (98 ± 4 d old). Liver biopsies were collected after 3 and 6 wks of exposure to SD (n = 6) or LD (n = 6) and evaluated for mRNA expression of *SOCS-1*, *SOCS-3*, enzymes of glucose and fatty acid metabolism (*phosphoenolpyruvate carboxykinase 1* [*PCK1*] and *2* [*PCK2*], *acetyl-coA carboxylase* α [*ACACA*], *fatty acid synthase* [*FASN*] and *very long chain acetyl-coA dehydrogenase* [*ACADVL*]), and a key transcription factor in lipid biosynthesis (*SREBP1-c*) by absolute quantitative real-time RT-PCR. Relative to LD, expression of *ACACA*, *ACADVL*, *SREBP-1c* and *PCK1* was decreased (P < 0.05) in steers exposed to SD for 6 wks. In addition, *SOCS-1* tended to be lower (P = 0.11) in SD steers after 6 wks. There was a tendency for an increase in *FASN* expression in SD steers at 3 wks (P = 0.06), but a suggested decline by 6 wks (P = 0.23). Expression of *PCK2* and *SOCS-3* was unaffected by photoperiod treatment. Based on our findings and those in rodents, we propose a mechanism whereby SD photoperiod lowers circulating PRL and *SOCS-1* expression, suppressing *SREBP-1c* and hepatic lipogenesis via reductions in *ACACA* and *FASN*. Suppressed hepatic lipogenesis may reduce the incidence or severity of fatty liver during metabolic imbalance. In conclusion, SD photoperiod treatment prior to calving may aid in the prevention of fatty liver and metabolic syndrome in dairy cows during the periparturient period.

Key Words: Photoperiod, Gene Expression, Fatty Liver

274 Effects of intramammary infusions of serotonin (5-HT) and methysergide (METH), a 5-HT antagonist, on milk production and composition in lactating dairy cows. L. L. Hernandez*[1], J. B. Wheelock[1], G. Shwartz[1], L. H. Baumgard[1], A. M. Parkhurst[2], and R. J. Collier[1], [1]*University of Arizona*, *Tucson*, [2]*University of Nebraska*, *Lincoln*.

The neurotransmitter 5-HT, synthesized from tryptophan, is a proposed feedback inhibitor of milk synthesis. We evaluated effects of intramammary infusions of 5-HT or METH on milk yield (MY) and composition in 6 multiparous lactating dairy cows. Cows were assigned to a repeated measures design of contralateral intramammary infusions with METH (20 mg/quarter/d) or 5-HT (50 mg/quarter/d). Udder halves were first treated with METH or saline (SAL) for 3d followed by a 7d washout period before administrating 5-HT or SAL. MY was recorded twice daily for each udder half and milk composition of each half was determined once daily. Daily blood samples were harvested for plasma to determine glucose and NEFA concentrations. Sweating rate (SR), respiration rate (RR), and left and right udder temperatures were obtained twice daily after milking. Infusions of METH and SAL increased MY 10.9% from beginning of infusion to end of infusion period (P<0.002). Infusions of 5-HT and SAL decreased MY by 11.1% compared to pre-5-HT infusion period and MY decreased further by 8.9% post-5-HT infusion (P<0.05). Infusions of SAL, METH, and 5-HT increased SCC (P<0.05). Infusing 5-HT tended to reduce mean lactose concentration (4.3%/vol) relative to SAL infusion (4.6%/vol; P=0.06). Milk protein was decreased by METH and SAL 2.0% compared to the post-infusion period (P=0.0001) and was increased 5.8% by5-HT and SAL compared to the pre-infusion period (P=0.02). SR increased 17% during intramammary infusion of 5-HT and decreased 33% post-infusion (P<0.0001). SR increased 11% by METH infusion and decreased 11% post-infusion (P<0.0001). No effect of 5-HT or METH infusions was detected on plasma NEFA or glucose concentrations, RR, or milk fat content. We conclude this data supports the concept of 5-HT as a feedback inhibitor of lactation.

Key Words: 5-HT, Milk Production, Feedback Inhibition of Lactation

275 Chitotriosidase activity in blood and colostrum at peripartum period in goats. N. Castro[1], J. Capote[2], A. Morales[1], C. Rodriguez[1], and A. Arguello*[1], [1]*Las Palmas de Gran Canaria University, Animal Science Unit*, *Arucas, Las Palmas, Spain*, [2]*Canary Agronomic Science Institute*, *La Laguna, Tenerife, Spain*.

Chitotriosidase (ChT) is a functional chitinase, with high homology to chitinases belonging to family 18 of glycosylhydrolases and present in different species. Predominantly it is a secretory protein but it is in part processed and stored in lysosomes. ChT mRNA is expressed only at a late stage of differentiation of monocytes to activated macrophages in culture indicating that the enzyme has a strongly regulated expression. Since ChT is able to cleave chitin present in the cell wall of fungi and nematodes, it is possible that this enzyme continues to play a role in defense mechanisms against parasites and fungi. There have been many studies of human ChT, but few of other mammalian endocrine chitinases. The aim of this study was to measure ChT activity in goat serum and colostrum around partum period. Blood from 30 Majorera breed goats was taken at -4, -3, -2, -1, 1, 2, 3, and 4 postpartum days, and colostrum was sampled at 1, 2, 3, 4, and 5 postpartum days. ChT activity was assayed in serum and colostrum using a fluorescence method. Blood serum ChT activity was 3887, 4023, 3682, 3333, 2658, 2955, 2575 and 3520 nMol/ml/h at -4, -3, -2, -1, 1, 2, 3, and 4 postpartum days respectively. No statistical effects of time were shown, but the lowest ChT activity level was measured around partum day.

Colostrum ChT activity was 3912, 2124, 737, 403 and 465 nMol/ml/h at 1, 2, 3, 4, and 5 postpartum days, respectively. Statistical differences ($P<0.05$) were shown between postpartum days.

Key Words: Chitotriosidase, Goat, Colostrum

276 Pre-pubertal nutrition affects mammary development and first lactation performance depending on growth potential in dairy sheep. A. Zidi[1], G. Caja*[1], M. Ayadi[2], V. Castillo[1], C. Flores[1], and X. Such[1], [1]*Universitat Autònoma de Barcelona*, *Bellaterra, Spain*, [2]*Institut Superieur de Biologie Appliquée de Medenine*, *Tunisia*.

A total of 57 ewe lambs of Manchega (MN, n = 35) and Lacaune (LC, n = 22) dairy sheep, born during winter and weaned at wk 5 of age, were used to evaluate the effects of pre-pubertal level of nutrition on long-term lactational performance. Nutritional treatments consisted of ad libitum (concentrate and alfalfa hay) or restricted (concentrate and straw) feeding to achieve the maximum ADG (MN, 254 g/d, n = 18; LC, 293 g/d, n = 12) or 65% ADG (MN, 164 g/d, n = 17; LC, 189 g/d, n = 10), respectively, from wk 5 to 22. After wk 22, ad libitum ewe-lambs joined the adult ewe flock for grazing (MN, 183 g/d; LC, 201 g/d; $P < 0.05$). Compensatory growth was applied to restricted ewe-lambs from wk 22 to 27 (MN, 223 g/d; LC, 279 g/d; $P < 0.05$) to reach puberty and pregnancy during first fall. All ewe-lambs were exposed to rams and mated under control conditions after the second estrus cycle. Computerized axial tomography (CAT) was done at wk 16 and 36. Puberty was reached earlier in ad libitum than in restricted fed ewe lambs (MN, -35 d; LC, -21 d; $P < 0.05$). CAT images at wk 16 showed greater fat pad ($P < 0.05$) due to ad libitum feeding in both breeds (MN, +54%; LC, +32%). Parenchyma percentage was lower in the ad libitum fed MN ($P < 0.05$), but no differences were detected between the other groups. Conception rate (50.9%), prolificacy (1.24 lambs/ewe) and lamb body weight at birth were not affected by the dietary treatments. Milk yield varied according to treatment and breed, the breed × treatment interaction being highly significant ($P < 0.001$). Restricted ewe lambs yielded more milk than ad libitum at first lactation (114 DIM) in MN (61.2 vs. 40.0 L; $P < 0.05$), whereas it was the opposite in LC (122.9 vs 143.5 L; $P < 0.05$). No significant differences in milk components were detected between feeding treatments, but milk of restricted MN had greater fat and protein contents.

Key Words: Dairy Sheep, Mammary Development, Lactation

Graduate Student Paper Competition: National ADSA Production Division

277 The relationship between negative energy balance and mastitis in dairy cattle during early lactation. K. M. Moyes*[1], T. Larsen[2], N. C. Friggens[2], J. K. Drackley[1], and K. L. Ingvartsen[2], [1]*University of Illinois*, *Urbana*, [2]*University of Aarhus*, *Tjele, Denmark*.

Our objective was to determine whether dairy cows experiencing more severe postpartal negative energy balance (NEB) are at a greater risk for developing mastitis during early lactation. Data from a total of 138 lactations from 117 cows were used in a case-control epidemiologic study. Cows were of 3 breeds (Danish Red, Danish Holstein and Jersey) ranging from parity 1 to 4. Blood samples were collected weekly from 56 d before expected calving date through 90 DIM. Blood was analyzed for insulin, aspartate aminotransferase (ASAT), NEFA, glucose and BHBA. Daily milk yield was measured and composite SCC were analyzed. Cows were classified as 1) healthy (H) if SCC < 100,000 cells/mL and they were not treated for mastitis; 2) sub-clinical mastitis (SM) if SCC > 800,000 cells/mL but were not treated for mastitis; or 3) clinical mastitis (CM) if SCC > 800,000 cells/mL and were treated for clinical mastitis. Cows that developed mastitis during the first 7 DIM were excluded from the dataset. The time of mastitis (TOM) was recorded as the DIM in which the first rise in SCC was observed and was recorded as TOM = 0. The time prior to and after TOM was distinguished as ± n wks relative to TOM = 0. Healthy cows were paired with either a SM or CM cow and the TOM for each H cow was equal to the TOM for their paired mastitic cow. Data from wk -2 relative to TOM were analyzed using the MIXED procedure of SAS. Cows that developed SM did not differ statistically from H cows. The CM cows had higher NEFA ($P<0.05$) and ASAT ($P<0.05$) than H cows. All other variables were similar among treatment groups. Cows in more severe NEB tended to have higher NEFA than cows experiencing 'normal' postpartal NEB. In addition, higher ASAT indicates that the CM cows may have experienced more liver tissue damage prior to the development of mastitis when compared with H cows. Our results indicate that cows experiencing more severe postpartal NEB may be at a greater risk for developing mastitis.

Key Words: Negative Energy Balance, Mastitis, Dairy Cattle

278 The use of the Rumensin Premix in dairy cows: factors influencing its effects on milk production and milk composition. J. Dubuc*[1], D. DuTremblay[1], M. Brodeur[1], R. Bagg[2], P. Dick[2], J. Baril[2], and L. DesCoteaux[1], [1]*Universite de Montreal*, *Saint-Hyacinthe, Quebec, Canada*, [2]*Elanco Animal Health*, *Guelph, Ontario, Canada*.

The goal of this field trial was to evaluate the effects of 16 ppm of monensin sodium (Rumensin Premix, Elanco Animal Health, Canada) on production (PROD) and milk fat percentage (MFP) of commercial dairy herds. Another goal of this study was to identify possible interactions between monensin and nutritional factors on PROD and MFP. A randomized clinical trial was conducted on 49 Holstein herds in Quebec (Canada) between Nov. 2005 and May 2006. The herd was considered as the unit of interest. Herds were balanced in two groups for milk production, housing system, feeding system and size of farm. Monensin treatment was allocated in a crossover designed trial for each group. Monensin premix was added to the lactating dairy cow rations for a consecutive 3-month period for every herd. PROD and MFP were from weekly averages of daily bulk tank data. PROD and MFP were considered as outcome variables in linear mixed models. PROD and MFP were treated as repeated measures in herds. All models included treatment, group, season, parity and days in milk as fixed effects. Majority of herds were fed total mixed rations (TMR; n=30; 61%) and were housed in tie-stalls (n=42; 86%). Overall monensin effect on PROD was not significant (P=0.54). However, herds having high non-fiber carbohydrate level (NFC; >41.0%) in their diet had a higher milk production (+0.84kg/d; P=0.03). Monensin had a decreasing effect (-0.12%) on MFP (P<0.01). Statistical interactions

with monensin on MFP were observed for some nutritional factors. The decreased MFP effects were larger for herds: having a diet high in NFC (>39.0%; P=0.01); having low particle size in TMR when adding the results of the two top sieves of The Pennsylvania State University Particle Separator (<45.0%; P=0.03); not feeding dry hay as first meal in the morning (P=0.05); and not feeding protected fat in the diet (P=0.07). The results of this trial confirm that monensin lowers MFP at a dose of 16 ppm in lactating dairy cows. Interactions between monensin and nutritional factors having effects on PROD and MFP were mostly related to carbohydrate levels in the ration.

Key Words: Monensin, Dairy Cow, Milk Composition

279 The expression of genes regulating lipolysis in the adipose tissue of pregnant and lactating dairy cattle. J. M. Sumner* and J. P. McNamara, *Washington State University*, *Pullman*.

There is great variation among dairy cattle in body condition loss during early lactation, which affects all aspects of production, health and longevity. The objectives were to determine the change in expression of the beta 1, beta 2, and beta 3 adrenergic receptors, hormone sensitive lipase and its cofactor perilipin in the adipose tissue of Holstein dairy cattle during transition. We also wanted to know if the expression was related to animal level variables for milk production and body fat. Therefore, twenty Holstein dairy cattle were grouped by lactation number (1, 2, and 3 or more) in a randomized design and subcutaneous adipose tissue was sampled to measure lipolytic rates and gene expression. Duplicate samples were extracted for RNA and tissue was also incubated to measure basal and stimulated lipolysis. Basal lipolysis increased following parturition, stimulated lipolysis peaked at 90 days postpartum. The beta-1 receptor relative expression increased relative to prepartum by 170%, 72% and 112% at 30, 90, and 270 DIM . The beta-2 receptor relative expression increased by 75%, 121% and 100% at 30, 90, and 270 DIM compared to 30 days prepartum. The beta-3 receptor increased 111%, 125% and 69% at 30, 90, and 270 DIM. Hormone sensitive lipase increased (P = 0.09) at all postpartum sample points and was highest in primiparous animals (P = 0.002). The mean fold increase was 180%, 359% and 47% at 30, 90, and 270 days of lactation compared to prepartum. The relative abundance of the perilipin gene was the highest and the relative expression increased (P = 0.04) 227%, 1847% and 126% at 30, 90, and 270 DIM. This is the first time perilipin has been measured in the adipose tissue of dairy cattle. Expression of hormone sensitive lipase was negatively related to changes in BCS. This work demonstrates that increases in the expression of beta-adrenergic receptors, hormone sensitive lipase and perilipin is part of the regulation of lipolysis in dairy cattle during lactation.

Key Words: Gene Expression, Adipose, Lipolysis

280 Feeding a whey protein gel to prevent rumen hydrogenation of unsaturated fatty acids and increase the n3 and n6 fatty acid content of goat milk. J. A. Weinstein*, E. J. DePeters, M. Rosenberg, S. J. Taylor, and A. Aljadeff, *University of California*, *Davis*.

Developing new approaches for reducing the risk of coronary disease from eating dairy products is a common objective in research, specifically, finding methods to increase the polyunsaturated fatty acid (PUFA) concentration of milk lipids. Previously, feeding whey protein gels containing PUFA reduced rumen biohydrogenation and increased the levels of target milk fatty acids. Our objective was to test the efficacy of whey protein isolate (WPI) gels produced in a steam tunnel, as a method to alter the fatty acid (FA) composition of the triacylglycerol (TG) fraction of milk lipids in goats. Three primiparous Lamancha goats in midlactation were fed three diets in a 3x3 Latin square design. Each animal was fed an isoenergetic grain mix with WPI added as a supplemental lipid containing either: (1) 100% soybean (S) oil, (2) 100% linseed (L) oil, or (3) a 50/50 blend (S/L) of both soybean and linseed oils. S served as a source of n6 FA and L was a source of n3 FA. Periods were 22 days with the first 10 days used as an adjustment phase followed by a 12-day experimental period. During the adjustment phase all goats received yellow grease (YG) as their dietary lipid to provide a baseline for milk FA composition. During the experimental phase each goat received its assigned WPI. Significant changes in FA concentration were determined at $P<0.05$. Milk FA concentrations of C18:2 and C18:3 were 1.92 and .51 g/100g TG when goats were fed YG. Relative to YG, WPI S increased both C18:2 and C18:3 in milk fat to 9.37 and 1.51g/100g TG respectively. The S/L gel also increased C18:2 and C18:3, 6.45 and 3.86g/100g TG respectively. WPI L produced milk fat containing 3.99 and 5.97 g/100g TG of C18:2 and C18:3. WPI gels reduced rumen biohydrogenation of PUFA and increased the n6 and n3 content of milk fat in lactating does. WPI gels are a practical and efficient method to deliver PUFA postruminally.

Key Words: Goat, Polyunsaturated Fatty Acids, Whey Protein Gel

281 Effect of time of AI and supplemental estradiol on pregnancy rates of lactating dairy cows. J. Hillegass*, J. E. P. Santos, F. S. Lima, M. F. Sheley, and M. F. S. Filho, *University of California*, *Tulare*.

Objectives were to compare pregnancy rates and losses for lactating dairy cows time-inseminated either at 48 or 72 h after $PGF_{2\alpha}$ and supplemented or not with estradiol prior to AI. Holstein cows, 971, were randomly assigned to one of four treatments arranged as a 2 x 2 factorial. All cows were pre-synchronized with injections of $PGF_{2\alpha}$ at 37 and 51 DIM. At 64 DIM, they received an injection of GnRH, followed 7 d later by $PGF_{2\alpha}$. Cows were then assigned to one of four treatments; cows in the CoSynch at 48 h (CoS48) received a final injection of GnRH at the moment of timed AI 48 h after $PGF_{2\alpha}$, whereas cows in the CoSynch at 72 h (CoS72) received GnRH and were timed AI 72 h after $PGF_{2\alpha}$. Half of the cows in each CoSynch received an injection of 1 mg of estradiol cypionate (ECP) 24 h after $PGF_{2\alpha}$. Therefore, the 4 treatments were: CoS48-ECP (n = 240), CoS72-ECP (n = 246), CoS4+ECP (n = 245) and CoS72+ECP (n = 240). Blood samples were collected and progesterone measured in plasma of all cows at 7 d prior to and at the first GnRH of the CoSynch, and cows were classified as anovular when progesterone < 1.0 ng/mL in both samples. Pregnancy was diagnosed by palpation per rectum at 40 and 68 d after AI. A subset of 123 cows had their ovaries examined by ultrasonography to determine diameter of ovulatory follicle and ovulation rate. These same cows had blood sampled to evaluate plasma estradiol and progesterone concentrations after ECP and induction of ovulation with GnRH. Prevalence of anovular cows at 64 DIM was 27.6%, but it was similar across all treatments (P = 0.19). Pregnancy rates at 40 and 68 d after AI or pregnancy loss were not affected by timing of AI (P = 0.27) or supplementation with estradiol (P = 0.13). Delaying timed AI to 72 h and supplementation with ECP increased

the proportion of cows displaying estrus at AI ($P < 0.0001$), and cows in estrus had increased pregnancy rates ($P < 0.0001$). These results indicate that delaying the day of AI from 48 to 72 h and supplemental ECP, in spite of increasing display of estrus at timed AI, did not improve reproductive performance of lactating dairy cows at first AI.

Key Words: Dairy Cow, Reproduction, Estradiol

282 Interactions of unsaturated fat or coconut oil with Rumensin on milk fat production might be mediated through inhibition of specific protozoal genera. C. Reveneau*, S. K. R. Karnati, C. V. D. M. Ribeiro, E. R. Oelker, B. Mathew, D. R. Bae, C. M. Drow, and J. L. Firkins, *The Ohio State University*, *Columbus*.

Feeding animal-vegetable (AV) fat or medium chain FA to dairy cows can decrease rumen protozoal count. In contrast, AV fat with Rumensin (R) can promote milk fat depression (MFD), whereas diets supplemented with coconut oil (CO; rich in medium chain FA) + R were not expected to cause MFD. In a 6x6 Latin square design (2x3 factorial), 6 rumen-cannulated cows were fed with +/-R (260 mg/d) and either: control (no fat), 5% AV, or 5% CO. Diets were balanced to have 21.5% forage NDF, 16.8% CP and 42% NFC. The mixed model included fixed (diet) and random (period, cow) effects. Contrasts were the main effects of: 1) Rumensin (+R), 2) fat supplementation (control vs. AV+CO, and 3) fat source (AV vs. CO); and 4 and 5) the interactions of R with contrasts 3 and 4. Significance was $P<0.05$ for main effects and $P<0.10$ for interactions. The log10 of concentrations of total protozoa (cells/ml) were not different from control (5.97) vs. AV (5.95) but decreased by 93% with CO (4.79). *Isotricha* and *Entodinium* decreased by 99 and 97% by CO, whereas *Epidinium* was unchanged. In contrast, *Epidinium* were 67% lower for the main effect of +R and decreased 92% when AV was supplemented with R. Total VFA concentration (130 mM) was not affected by diet, but the A:P ratio decreased for CO (1.85) vs. control (2.95) or AV (2.58). The low A:P ratio was associated with a decreased total tract digestibility of NDF for CO (35.5%) vs. control (53.3%) and AV (46.5), with no difference in OM digestibility (averaging 67.9%). DMI was 5 kg/d lower with CO (15.3 kg/d) and not different for control and AV. Milk production was lower with +R (31.6 kg/d) and CO (30.3 kg/d) than AV (33.0 kg/d). MFD occurred with AV+R and CO: 1.08, 1.01, 0.71, 1.05, 0.87, and 0.74 kg/d for control, AV, CO, control+R, AV+R, and CO+R, respectively. Further analyses should elucidate the role of protozoal concentration and genera on bacterial biohydrogenation in the rumen.

Key Words: Protozoal Inhibition, Supplemental Fat, Milk Fat Depression

283 Effect of mannan-oligosaccharides on the mucosal immune system of dairy calves. V. C. Quezada*, B. B. Babatunde, and T. L. Frankel, *La Trobe University*, *Bundoora, Victoria, Australia*.

Eighteen Friesian bull calves were used to evaluate the effects of mannan-oligosaccharides (MOS) on immunity, in particular its effects on the jejunal and ileal Peyer's patches (PP) of the mucosal immune system. Pairs of age matched calves were obtained from two dairy farms over a 6 month period and were fed colostrum during the first 24 hours and commercial milk replacer (CMR) thereafter. At 2-3 days of age they were divided into groups and fed CMR only (CON) or CMR supplemented with 4 g of MOS/day. Blood samples were collected at 2-3 and 21 days of age. At 21 days of age 5-bromo-2′deoxyuridine was administered intravenously to detect cell proliferation and calves were killed 1 hour later. Samples from the jejunal and ileal PP were removed for histological examination. Paraffin embedded sections were stained to measure morphology, cell proliferation and distribution of T and B cells in the villi, follicles, domes and interfollicular areas of the PP. Data was analysed with a t-test assuming equal variances. The decrease in serum IgG from days 2-3 to 21 was significantly less in MOS (-2.7 ± 0.8 mg/ml) than CON calves (-6.9 ± 1.4 mg/ml) ($P<0.05$, $n = 8$). Height of ileal villi was greater in MOS (379.4 ± 25.1 μm) compared with that of CON calves (313.6 ± 23.8 μm) ($P<0.05$, $n = 7$). Cell proliferation in jejunal PP follicles was lower in MOS (29.4 ± 2.7 cells/mm) than CON calves (38.9 ± 3.1 cells/mm) ($P<0.05$, $n = 7$) but numbers of T cells in jejunal PP domes was greater (28.3 ± 2.5/mm vs 21.6 ± 2.6/mm, $n = 7$). In the ileum the only significant ($P<0.05$) difference in PP between MOS and CON calves was B cell numbers in the interfollicular area (24.0 ± 5.7/mm vs 44.6 ± 8.1/mm, $n = 6$). Supplementing CMR of calves from 2-21 days of age with MOS had a beneficial effect on IgG levels. The effect of MOS on the mucosal immune system appeared, through reduced cell proliferation, to reduce its rate of development but the increased T cell numbers suggest an improvement in the defense functions of the PP.

Key Words: Calves, Mannan-Oligosaccharides, Peyer's Patches

284 Effect of anion supplementation to low potassium prepartum diets on macromineral status and performance of periparturient dairy cows. J. M. Ramos-Nieves*[1], B. J. Thering[1], P. W. Jardon[2], and T. R. Overton[1], [1]*Cornell University*, *Ithaca, NY*, [2]*West Central®*, *Ralston, IA*.

Holstein cows (n=43) entering second or greater lactation were used to determine whether further supplementation of anions to low potassium (K) prepartum diets would improve periparturient macromineral status and performance. Beginning 21 d before expected parturition, cows were fed either a control diet (1.29% K, +10 mEq/100 g; n=21) or an anionic diet (1.29% K, -15 mEq/100 g; n=22) with anions provided through a combination of sulfate from calcium sulfate (0.40% S total ration) and chloride (1.17% Cl total ration) from SoyChlor$^{\$|reg;}$ 16-7 (West Central, Ralston, IA) in a completely randomized design. All cows were fed the same postpartum diet from parturition through 63 d postpartum. Feeding anions decreased overall urine pH (8.17 vs. 6.70, $P < 0.001$) during the prepartum period. Concentrations of plasma Ca tended to be increased in the two samples collected during the first 24 h postcalving (7.12 vs 7.99 mg/dL; $P < 0.07$) for cows fed the anionic diet prepartum. Overall concentrations of plasma P tended to be increased by feeding the anionic diet prepartum (5.05 vs. 5.36 mg/dL; $P < 0.09$); this effect was more pronounced during the immediate peripartal period (treatment by day, $P < 0.05$). Anionic supplementation did not affect incidence of clinical (< 5 mg/dL) and subclinical (5 - 8 mg/dL) hypocalcemia and clinical hypophosphatemia (<2 mg/dL), but subclinical hypophosphatemia (2 - 4 mg/dL) tended ($P < 0.09$) to be decreased at 16 h postcalving and was decreased ($P < 0.02$) at d 2 postpartum for cows fed the anionic diet prepartum. Anionic supplementation decreased prepartum DMI (15.6 vs. 14.4 kg/d; $P < 0.01$), but did not affect postpartum DMI (22.4 vs. 23.0 kg/d; $P = 0.36$), milk yield (46.5 vs. 46.1 kg/d; $P = 0.88$), or content and yield of milk fat and true protein. Overall, anion supplementation to low K diets improved Ca status on the day after calving and P status

during the early postpartum period, but did not affect periparturient performance.

Key Words: Cation-Anion Difference, Mineral, Dairy Cow

285 Effects of an injectable chelated mineral supplement on dairy calf performance. J. R. Crenwelge*[1], T. D. Nennich[2], B. D. Lambert[1,2], N. M. Cherry[2], and E. R. Jordan[3], [1]*Tarleton State University*, *Stephenville, TX*, [2]*Texas A&M University*, *Stephenville*, [3]*Texas A&M University*, *Dallas*.

In recent years, the use of trace mineral supplements to maximize growth or production of calves has gained the interest of researchers. Past research has found that trace mineral supplements may assist in enhancing immunity of the young, growing animals; but the role of these supplements on animal performance has varied. The overall objective of these studies was to determine the affect of supplementing a chelated injectable mineral product (MIN), containing 16 mg Cu/ml, 10 mg Mn/ml, 5 mg Se/ml, and 48 mg Zn/ml, on average daily gain (ADG), as well as blood and liver mineral concentration, of pre-weaned dairy calves. To meet the objectives, two separate studies were conducted. The first study (Study 1), a completely randomized design, included 123 Holstein heifers housed at a commercial dairy heifer operation. Treatment calves (n = 60) received an injection (1 ml) of MIN at one day of age. All calves were weighed at 3±2 and 42±3 days of age to determine ADG. Study 2 included ten Holstein bull calves, with treatment calves (n = 5) receiving an injection of MIN at 4 days of age. Blood samples and liver biopsies were collected 1 d previous to injection and 39 d after receiving the injection. In Study 1, calves were fed milk-replacer and calf starter; while in Study 2, calves were fed waste milk and calf starter. Average daily gains of calves receiving the mineral injection did not vary significantly ($P > 0.05$) from the control calves. The ADG for Control and MIN groups were 0.29 and 0.30 kg/d, and weaning weights were 49.0 and 50.1 kg, respectively. In Study 2, ADG for Control and MIN calves were not significantly different ($P > 0.05$) and averaged 0.49 and 0.50 kg/d, respectively. No significant treatment differences were observed in blood and liver mineral concentrations in Study 2. In summary, an injection of this chelated mineral product at birth did not significantly affect the ADG or blood and liver mineral concentrations of the dairy calves in these studies.

Key Words: Dairy, Calves, Chelated Minerals

286 Calcium and phosphorus balance and bone mobilization through lactation with varying dietary calcium concentrations. M. S. Taylor*[1], K. F. Knowlton[1], M. L. McGilliard[1], W. S. Swecker, Jr.[1], J. D. Ferguson[2], and Z. Wu[2], [1]*Virginia Polytechnic Institute and State University*, *Blacksburg*, [2]*University of Pennsylvania*, *Kennett Square*.

The timing and extent of calcium (Ca) and phosphorus (P) mobilization from bone was evaluated through 20 wk of lactation to determine extent and timing of net resorption of bone mineral. Eighteen Holstein cows were blocked by parity, previous lactation milk yield, and calving date and randomly assigned to treatment. At calving cows began treatment diets of high Ca (1.1%, High), medium Ca (0.75%, Med), or low Ca (0.45%, low) concentration. Dietary P was 0.36% in all diets. Total collection of milk, urine, and feces was conducted 2 wk prior to calving and in wk 2, 5, 8, 11, and 20 of lactation. Blood samples were collected at -14 and -10 d prior to calving and 0, 1, 3, 5, 10, 14, 21, 28, 35, 56, 70, 84, 98, and 140 d relative to calving. Blood samples were analyzed for Ca, P, Mg, and parathyroid hormone concentration. Serum concentrations of osteocalcin (OC), a marker of bone formation, and deoxypyridinoline, a marker of bone resorption, were measured to determine bone mobilization. Rib bone biopsies were conducted within 10 d of calving and during wk 11 and 20. This was a complete randomized block design with significance declared at $P < 0.05$. Calcium retention increased until wk 11 and then decreased. At wk 20 Ca balance was 66.7, 40.8, and 25.5 g/d for the High, Med, and Low diets, respectively. Phosphorus balance increased until wk 20 and then decreased. Feces Ca and P excretion were higher in multiparous than in primiparous cows (153.3 vs.128.9 g Ca/d; 58.0 vs.44.8 P g/d). Serum P was lower in multiparous than in primiparous cows (4.9 and 5.4 mg/dl). Serum Ca and P were not affected by treatment. Primiparous cows had higher serum OC concentrations than multiparous cows (68.3 vs.43.2 ng/ml). Week affected urine Ca and P excretion, feces Ca and P excretion, serum P, Mg, and OC concentration. Primiparous cows appear to be building more bone regardless of dietary treatment. This information may help refine dietary mineral recommendations and ultimately reduce their excretion.

Key Words: Calcium, Bone, Cows

287 Ovulation and CL development in mature cows given pLH or GnRH. T. O. Ree*[1,2], M. G. Colazo[3], D. J. Ambrose[3,2], A. G. A. Lamont[2,3], J. P. Kastelic[4], M. K. Dyck[2], R. J. Mapletoft[5], and B. N. Ametaj[2], [1]*Lakeland College*, *Vermilion, AB, Canada*, [2]*University of Alberta*, *Edmonton, AB, Canada*, [3]*Alberta Agriculture and Food*, *Edmonton, AB, Canada*, [4]*Agriculture and Agri-food Canada*, *Lethbridge, AB, Canada*, [5]*University of Saskatchewan*, *Saskatoon, SK, Canada*.

The effects of porcine LH (pLH) versus GnRH on ovulatory response (OR) during diestrus and proestrus, and on corpus luteum (CL) development were examined. In Expt 1, nonlactating cows (24 dairy, 51 beef) were given a progesterone (P4; 1.9 g) insert (CIDR) for 10 d and 500 µg cloprostenol (Estrumate; PG) at CIDR removal. Estrus detection (estrus=D0) was done 3x/d for 5 d. On D5 follicles (>8mm) were ablated. On D12, cows received, in a complete random design, 25, 12.5 or 8 mg pLH (Lutropin-V), or 100 µg GnRH (Fertiline; n=18 or 19/group), at which time plasma P4 was 5.6±0.2 ng/mL (mean±SEM; no effect of group). Ovulation was determined by ultrasonography at 27, 48 and 72 h. The OR to 25 mg pLH (84%) or GnRH (72%) was higher ($P<0.05$) than to 8 mg pLH (32%); OR to 12.5 mg pLH tended to be lower ($P<0.07$; 58%) than to 25 mg pLH. In Expt 2, 68 cows were given PG 2x, 10 d apart. Estrus was detected as in Expt 1, and on D7, cows were given PG; 36 h later (P4=0.3±0.05 ng/mL; no effect of group), they were given pLH or GnRH as in Expt 1 (17 cows/group). Ovulation was determined at 27, 36, 48, and 72 h. In a subset of 17 cows, blood (for P4) and CL data were collected every 48 h for 14 d. Data were analyzed using Proc FREQ (chi-square) or MIXED (repeated measures) in SAS. All cows ovulated; interval from treatment to ovulation did not differ among groups, but was most variable ($P<0.01$) in cows given 8 mg pLH (28.1±0.7, 29.1±1.0, 33.5±2.8, and 29.1±1.0 h for 25, 12.5, or 8 mg pLH and GnRH, respectively). Although CL area (mm^2) was larger ($P<0.02$) in cows given 25 mg pLH (301.5±22.6) or GnRH (305.2±22.6) than those given 8 mg pLH (222.1±22.7), it did not differ from 12.5 mg pLH (260.8±20.3). Mean

plasma P4 was higher (P<0.04) in cows given 25 mg pLH (3.5±0.3) or GnRH (3.8±0.3) than those given 8 mg pLH (2.4±0.3); P4 was lower with 12.5 mg pLH (2.6±0.3) than with GnRH (P<0.02), and tended (P<0.07) to be lower than with 25 mg pLH. In summary, cows given 25 mg pLH or 100 µg GnRH had greater OR, CL area, and plasma P4 than those treated with 8 mg pLH; 12.5 mg pLH gave intermediate responses. A dose of 8 mg pLH was not consistently effective for synchronizing ovulation in mature cows.

Key Words: Porcine LH, GnRH, Ovulatory Response, CL Development

288 Early postpartum biochemical and management characteristics related to dairy cow removal. C. S. McConnel*, S. M. Hiibel, J. A. Kidd, A. E. Hill, and F. B. Garry, *Colorado State University*, *Fort Collins*.

A large proportion of dairy cow death is concentrated within the early postpartum period. Detection of discriminating characteristics within this period may be useful for defining cows at risk for premature removal from a herd. This nested case-control study explored the value of analyzing standard biochemistry and management characteristics of early postpartum cows in determining features related to removal (death and culling). Serum was collected from cows at 3 to 5 days postpartum on two intensive, Colorado dairies. Biochemistry panels for 47 cows that were removed from the dairies within 30 days of parturition (cases) were compared with herd cohorts surviving through 100 days in milk (controls), matched by calving date and lactation. Wilcoxon signed-rank test analysis demonstrated that levels of calcium, total protein, albumin, total bilirubin (TB), creatine kinase (CK), aspartate aminotransferase (AST), potassium, and anion gaps differed significantly between cases and controls (P<0.05). Associations between dairy cow removal and biochemical (19) and animal management characteristics (4) were evaluated univariately via a Chi-square test. Ten variables with P<0.15 were selected for ordinal logistic regression analysis. Stepwise backward and forward selection resulted in four significant variables (P<0.1): TB, CK, AST, and drench administration. The odds of removal were 3.3, 2.8, and 5.7 times higher among cows with elevated levels of TB, CK, and AST. The odds of removal were 5.7 times higher among cows that were assessed to need systemic treatment in the form of a drench. Appropriate fresh cow management may be guided through adjunctive biochemical analysis, highlighting areas that require modification in an effort to improve postpartum health, such as transition cow and calving management, post-partum cow-side evaluation, and therapy protocols. Similarly, fresh cow assessment that recognizes discriminating systemic characteristics (as evidenced by the application of a drench in this study) may provide insight into useful modifications for individual sick cow management.

Key Words: Dairy, Removal, Biochemistry

289 Effect of dietary energy and metabolizable protein in lactating dairy cows. A. G. Rius*, M.L. McGilliard, and M.D. Hanigan, *Virginia Polytechnic Institute and State University*, *Blacksburg, VA, USA*.

The objective of the study was to test NRC (2001) model predictions of energy and protein requirements for the dairy cow. We hypothesized that energy and protein have additive effects on production as opposed to the independent limiting effects assumed by the NRC. A complete randomized design in a 2x2 factorial arrangement was used with high and low energy (1.55 [HE] or 1.44 [le] Mcal NEL/kg DM) and RUP (6.5 [HP] or 4.5% [lp] RUP). Multiparous Holstein (n=32) and Jersey by Holstein cross-bred (n=8) cows were randomly assigned to one of the four dietary treatments (HEHP, HElp, leHP, and lelp). A common diet (HEHP) was fed from d 1 through 21 followed by the respective treatment diets from d 22 to 40. Diets were formulated for CP contents of 17.0 or 14.4%, and a constant RDP content of 10.4% using the NRC model. Feed intake, milk yield and body weight were measured daily. Milk composition and BCS was measured on weeks 3 and 7. The Proc Mixed procedure of SAS was used to test the main effects and their interactions. Milk yields were not significantly affected by treatment however, there was a tendency (P<0.09) and the LSM were 35.0, 33.5, 31.3 and, 26.8 kg/d for HEHP, HElp, leHP, and lelp respectively (SEM=2.4). Although milk yields were significantly different (P< 0.05) for the average of HElp and leHP vs lelp (5.6;SEM=2.8), there was no difference (P< 0.41) between HEHP vs the average of HElp and leHP (2.5; SEM=3). Milk protein yields were significantly affected by treatment (P< 0.05) with LSM of 1.09, 1.01, 0.92 and, 0.88 kg/d; (SEM=0.06). The DMI was significantly affected by treatment (P< 0.05) with LSM of 25.2, 25.0, 25.6, and 23.1 kg/d (SEM=0.69) for HEHP, HElp, leHP, and lelp treatments, respectively. Non-fat milk solids yields tended to be lower (P< 0.08) when dietary energy was limiting with LSM of 3.11, 2.97, 2.68, and 2.42 kg/d (SEM=0.04). The results indicate that lower RUP diets can be fed with high energy diets without compromising milk production whereas the combination of low energy and low RUP significantly depressed milk and milk protein yields.

Key Words: Cow, Energy, Protein

Nonruminant Nutrition: Poultry Nutrition - Gut Health and Early Nutrition

290 Maternal dietary conjugated linoleic acid causes embryonic mortality in the absence of vitelline membrane disruption. V. A. Leone*[1], R. Aydin[2], D. Stransky[1], and M. E. Cook[1], [1]*University of Wisconsin*, *Madison*, [2]*Kahramanmaras Sutcu Imam University*, *Kahramanmaras, Turkey*.

We have previously shown that conjugated linoleic acid (CLA) fed to the laying hen in a low-fat diet reduced hatchability when eggs were stored at 4°Celsius (C) for 24 hours. Mineral analysis of yolk and albumin of eggs from CLA-fed hens stored at 4°C for 10 weeks showed a significant change in mineral composition of Ca2+, Mg2+, Fe3+, Na+, Cl- and Zn2+ compared to eggs from control-fed hens. This suggests cooling CLA-containing eggs causes disruption of the vitelline membrane, altering mineral balance, and reducing hatchability. An experiment was performed to determine if maternal CLA-feeding reduced hatchability in the absence of vitelline membrane disruption. Hens (24) were assigned to diets containing 1% Corn Oil (CO) or 1% CLA-80 (40% c9, t11 and 40% t10, c12 isomers), and were artificially inseminated once weekly beginning one week prior to the onset of experimental feeding. Eggs were collected daily and placed directly in the incubator. Production, fertility, and hatchability were recorded.

Eggs were candled daily, and eggs that candled clear or early dead were further assessed. Day of embryonic mortality was recorded (expressed as embryonic days of survival). Production and fertility were not altered by CLA. Hatchability fell to 0% after 15 days of CLA-feeding, while control stayed at 80%. Over a 3-week assessment period of embryonic survival, average days of embryonic survival from the CLA group diminished to 16.68 days, while the CO group stayed at 20.78 (21 days of survival results in a hatched chick) during the second week of feeding. During the third week, average days of embryonic survival from the CLA treatment was reduced to 6.33 days, while CO was at 19.77 days. This suggests that without the disruption of the vitelline membrane, embryonic days of survival and hatchability were still significantly reduced by maternal feeding of 1% CLA in comparison to control-fed hens. Further studies are needed to assess the causes of embryonic mortality seen in the presence of CLA, without the artifact of vitelline membrane disruption.

Key Words: Conjugated Linoleic Acid, Embryonic Mortality, Vitelline Membrane

291 Gluconeogenesis and carbon utilization in day 20 chicken embryos supplemented *in–ovo* with glucose and amino acids. N. E. Sunny*, J. Adamany, S. L. Owens, and B. J. Bequette, *University of Maryland*, *College Park*.

Late–term chicken embryos undergo a dramatic metabolic transition from maintaining high rates of gluconeogenesis *in–ovo* from amino acids and triglyceride–glycerol to maintaining high rates of lipogenesis ex–ovo from dietary carbohydrates and amino acids. The aim of this study was to quantify gluconeogenesis and glucose carbon utilization in small and large egg embryos (d 20) supplemented *in–ovo* with nutrients. Groups of small (n = 5 to 8; 54 to 58 g) and large (n = 5 to 8; 66 to 70 g) eggs were randomly dosed into the amniotic fluid on d 9 embryonic with either sterile water (200 µL, C), glucose (100 mg in 200 µL, G), an amino acid mixture (100 mg in 200 µL, AA) or a mixture of glucose and amino acids (50 mg of each in 200 µL, G+AA). Beginning on d 17 embryonic, each egg was given a daily dose of [U-^{13}C]glucose (15 mg/d in 75 µL water) into the amniotic fluid followed by tissue and blood collection on d 20. Blood was analyzed by mass spectrometry for ^{13}C–mass isotopomer distribution in glucose, alanine, aspartate and glutamate. Embryonic weights on d 20 were lower ($P \leq 0.001$) for the small vs. large eggs, and *in–ovo* nutrient treatment did not affect weights in either group (small: C 31.8, G 31.6, AA 31.3, G+AA 32.7 g; large: C 36.8, G 36.8, AA 37.1, G+AA 38.1 g). Despite differences in embryo weights, absolute rates of gluconeogenesis (0.72 ± 0.184 g/d) and glucose carbon recycling (59 ± 0.051 %) were similar between small and large eggs, and in–ovo nutrient supplementation did not affect these glucose fluxes. However, the contribution of glucose carbon to alanine flux was greater ($P = 0.002$) for the C (36 ± 0.042 %) and G (40 ± 0.045 %) treatment groups compared to the AA (25 ± 0.040 %) and G+AA (20 ± 0.034 %) treatment groups. In summary, *in–ovo* supplementation of AA or a mixture of G plus AA reduced glycolysis and the entry of glucose carbon into Krebs cycle metabolic pathways, irrespective of embryonic size.

Key Words: Gluconeogenesis, Embryo, Metabolism

292 Changes in the late term turkey embryo metabolism due to *in ovo* feeding. J. E. de Oliveira*[1], P. R. Ferket[1], C. M. Ashwell[1], Z. Uni[3], and C. Heggen-Peay[2], [1]*North Carolina State University*, *Raleigh, NC*, [2]*PAH-Embrex*, *Durham, NC*, [3]*Hebrew University of Jerusalem*, *Rehovot, Israel*.

Microarray technology has been shown to be an effective method to evaluate changes in gene expression of carbohydrate and lipid metabolism during embryonic development of turkeys. This research revealed that the embryo switches from lipid metabolism to carbohydrate (CHO) metabolism fueled by gluconeogenesis around day 22 of incubation (E), and that the liver is very active producing and utilizing glycogen almost simultaneously from E24 until hatch. These results were then used to formulate an in ovo feeding (IOF) solution hypothesized to promote CHO metabolism of late-term turkey embryos. Viable Nicholas turkey eggs of similar weights (85.2 g ± 10) were in ovo fed a 0.4 ml nutritive solution at E24. Liver samples were collected from 16 eggs each from IOF and control treatment-groups at E25, E26 and E28 (hatch), and RNA was isolated for microarray evaluation. The arrays were spotted with 300 genes selected to represent several aspects of general metabolism. At each day of incubation, the expression of several genes were significantly ($p<0.01$) different among the treatment groups. The IOF treatment clearly altered the expression of genes related to energy metabolism and growth, which may help to explain positive effects of *in ovo* feeding on hatchability, development, and growth of poults.

Key Words: In Ovo Feeding, Turkey Embryo, Microarrays

293 *In ovo*-fed lactose augments small intestinal surface and body weight of 3 day-old turkey poults. D. V. Bohórquez*, A. A. Santos Jr., and P. R. Ferket, *North Carolina State University*, *Raleigh*.

Avian neonatal development relies on nutrient digestion and absorption, which is integral to gut function and morphological development. Lactose, an indigestible disaccharide in poultry, and *Spirulina pacifica* may stimulate compensatory morphological development of the gut epithelium in poults. *Spirulina pacifica* is an alga that provides protein (65%), carbohydrates (20%), fat (7%) and minerals (5%). Three hundred Nicholas turkey eggs were weighed and equally distributed among 3 treatments: 1) Non-injected CONTROL, 2) Lactose-hydrate (LAC) (9% of solution) and 3) Spirulina pacifica + Maltodextrin (Sp+M) (1.4% and 10% of the solution respectively). Using Inovoject® V2303 (Embrex, Inc.), 1.5ml LAC and Sp+M solutions were injected into the amnion of turkey embryos at 22d of incubation (22E). Upon hatching, poults were fed a corn/SBM-based diet that met or exceeded the NRC recommendations up to 3d of age. Body weight (BW) was determined at 1 and 3d of age. At 1d, ileum histomorphometry (10 villi/bird) was assessed (10 poults/treatment). Villus measurements were: height (VH), apical width (VAW), basal width (VBW), crypt depth (CD), muscularis depth (MD) and mucosal height (MH). Villus height-crypt depth ratio (V:C) and apparent villus surface area (VS) were also calculated. BW was improved at 1d by both treatments (Sp+M and LAC) as compared to control (66.0, 65.5 vs 64.3g, $P<0.1$, respectively), yet only LAC maintained significantly higher BW at 3d (90.8 vs 85.7g, $P<0.05$). In ovo Sp+M feeding did not significantly affect histomorphometrical measurements. In contrast, in ovo LAC significantly increased VH (142.0 vs 119.8µm, $P<0.01$), MH (183.3 vs 162.4µm, $P<0.01$), V:C (3.45 vs 2.87µm:µm, $P<0.01$) and enlarged VS by 18% (4846 vs 3963µm^2, $P<0.01$) compared to the control at 1d. *In ovo*-fed lactose enhanced intestinal development by decreasing cell

turnover (higher V:C) and expanding intestinal surface area, which may boost nutrient absorption and bird performance.

Key Words: Turkeys, *In ovo*-fed Lactose, Intestinal Development

294 Development of an automated delivery system for *in ovo* feeding of turkey embryos. C. L. Heggen-Peay*[1], M. Garrell[1], V. W. Doelling[1], and P. R. Ferket[2], [1]*PAH-Embrex*, *Durham, NC*, [2]*North Carolina State University*, *Raleigh, NC*.

The turkey industry experiences up to 5% poult mortality losses due to starve out. Many of these poults have insufficient energy reserves left after hatch to sustain them through the first few days until they initiate feed intake and develop adequate digestive capability. *In ovo* feeding administers a nutritional formulation to embryos prior to hatch to provide substrates and co-factors that stimulate carbohydrate metabolism and intestinal development. To deliver *in ovo* feeding to turkey embryos on a large scale, an automated delivery system was developed. Injection studies were conducted to optimize the system for amnion targeting in embryonated turkey eggs at 22, 23, and 24 days of incubation (E). In each study, approximately 100 viable eggs/treatment were injected with Coomassie blue dye using an automated *in ovo* delivery system, embryos were immediately euthanized, and eggs were necropsied to evaluate site of injection. Eggs from both the Nicholas and Hybrid breeds were assessed. With Nicholas eggs, very good amnion targeting was achieved at both E24 (96.0% using a 20 gauge 1.125″ needle) and at E23 (90.5% using a 20 gauge 1.25″ needle). Successful amnion targeting in Nicholas eggs was not achieved at E22. In Hybrid eggs, excellent amnion targeting was achieved at E23 (97.8% using a 20 gauge 1.25″ needle) and E24 (96.1% using a 20 gauge 1.25″ needle). These results support optimization of an automated *in ovo* delivery system for amnion targeting in turkey eggs.

Key Words: Turkey, Amnion, *In ovo*

295 Evaluation of microbiota populations and intestinal development of different genetic lines of chickens. B. S. Lumpkins*, A. B. Batal, and M. D. Lee, *University of Georgia*, *Athens*.

The gastrointestinal tract (GIT) provides an environment for a large and diverse population of intestinal microbiota, which is unique among animal species. In the poultry industry, producers use different genetic lines of chickens with varying rates of development based on their production goal, but little is known about how the microbiota community relates to the genetic lines of chickens based on the varying rates of development. Therefore, a 35 d experiment was conducted to observe and evaluate the changes in the microbiota populations and GIT development of Cobb 500, Ross 708, and Athens Canadian Random bred (ACR) chicks. All birds were fed a standard non-medicated corn-soybean meal diet ad libitum from 0 to 35 d of age. Intestinal measurements and bacterial analysis of the jejunum and ileum were conducted at 4, 7, 14, 21 and 35 d of age. The bacterial DNA was isolated from the digesta, and denaturing gradient gel electrophoresis (DGGE) and terminal restriction fragment length polymorphism were used to examine PCR amplified fragments of 16s ribosomal DNA. Cobb chicks performed the best from 0 to 14 d of age; however, the overall performance was similar for Cobb and Ross chicks. The ACR chicks had the worst performance at all periods measured. The overall relative weight of the jejunum and ileum was not different between the 3 genetic lines, but the ACR chicks had longer relative jejunum and ileum lengths compared to the Cobb and Ross chicks from 0 to 35 d. Furthermore, the Cobb chicks had the longest villi height, while the ACR chicks had the shortest villi height in the jejunum and ileum at all measuring periods. Based on DGGE, the Cobb and Ross chicks had similar microbiota communities at similar ages. Regardless of the genetic line of chicks the microbiota populations changed with age. The performance, GIT measurements, and microbiota population of the Cobb and Ross chicks were similar, while the ACR GIT measurements and microbiota community differed. The results indicate that the different genetic lines have varying rates of intestinal development, which impact performance and the microbiota community.

Key Words: Microbiota, Gastrointestinal Tract, Genetic Lines

296 Effects of diet type, enzyme addition and *Clostridium perfringens* challenge on growth performance and gut health of broiler chickens. W. Jia*[1], B. A. Slominski[1], H. L. Bruce[2], G. Blank[1], and O. Jones[3], [1]*University of Manitoba*, *Winnipeg, Canada*, [2]*Maple Leaf Food Agresearch*, *Burford, Canada*, [3]*Canadian Bio-Systems Inc.*, *Calgary, Canada*.

The effects of diet type (corn- vs wheat-based), enzyme addition (none or multi-carbohydrase preparation at 0.2 g/kg diet) and oral challenge with *Clostridium perfringens* (none or 10^9 CFU/bird on day 13) on growth performance, digesta pH and viscosity, *C. perfringens* intestinal population and gut lesion score (from 0 to 4 where 0 = no gross lesions, 4 = severe extensive necrosis) were studied in a 40-day experiment with broiler chickens. A total of 1216 male Ross-308 chickens was assigned to 8 dietary treatments in a randomized complete block design providing 8 replicate pens per treatment. Diets were formulated to meet protein requirement of NRC but were suboptimal in energy level. When compared with corn, birds fed wheat-based diets had inferior weight gain (55.0 vs 58.4 g/bird/day) and feed efficiency (1.71 vs 1.62 g feed/g gain). Pathogen challenge significantly ($P<0.05$) impaired growth performance and increased *C. perfringens* population in the gut and intestinal lesion score. Increased digesta *C. perfringens* counts (2.4 vs 1.5 CFU/g) and intestinal lesion score (0.9 vs 0.4; $P<0.01$) were observed for challenged birds fed wheat-based diets. No difference in digesta pH was found among the treatments. Enzyme addition resulted in increased weight gain (59 vs 56 g/bird/day; $P<0.01$) in challenged birds fed corn-based diets; whereas in those fed wheat-based diets, enzyme supplementation improved feed efficiency during the grower-finisher phase (1.9 vs 2.0; $P<0.01$). A significant reduction in digesta viscosity (from 4.1 to 2.7 mPa.s; $P<0.01$) was observed in birds fed enzyme-supplemented wheat-based diets. In conclusion, enzyme addition had beneficial effect on growth performance and minimized the negative effect of *C. perfringens* challenge.

Key Words: Broiler Chicken, Enzyme, *Clostridium perfringens*

297 The effect of dietary sinapic acid on the gastrointestinal tract microbial fermentation, nutrient utilization and egg quality of laying hens. M. Johnson*, A. A. Olkowski, and H. L. Classen, *University of Saskatchewan*, *Saskatoon, SK, Canada*.

Plant based simple phenolics, such as sinapic acid, are natural antimicrobial and antioxidant compounds. As such, they have potential to modulate gastrointestinal tract (gut) microorganisms to influence

performance and also influence the quality of food products when fed to food animals. An example of a simple phenolic that might be found in poultry diets is sinapic acid, which is the predominant simple phenolic acid found in canola meal. Sinapic acid has previously been shown to improve nutrient retention and affect gut microbiota in broiler chickens, and also to have bactericidal activity against *Salmonella enterica* subsp. *enterica in vitro*. Therefore it was of interest to investigate the impact of dietary sinapic acid in laying hens. Two experiments were conducted to investigate the impact of dietary sinapic acid on fermentation patterns of laying hen gut microbiota as judged by volatile fatty acid (VFA) level, energy and protein retention, and the deposition of sinapic acid in eggs. In trial one, hens were randomly assigned to groups of ten that were fed diets containing 0, 0.025, 0.050 or 0.075% sinapic acid for a total of 4 weeks. Dietary sinapic acid in trial one did not affect jejunal, ileal or cecal VFA level, energy and protein retention or any production trait. Sinapic acid was not found in eggs. To determine if a higher level of sinapic was required to cause an effect, the second trial used twenty hens to compare the effect of 0 and 0.5% dietary sinapic acid. Sinapic acid inclusion again failed to affect gut VFA levels. However, sinapic acid increased both the retention of energy (AME) and protein in comparison to the un-supplemented diet. Feeding sinapic acid also resulted in low levels being found in the yolk and albumen of eggs. The results indicate that dietary sinapic acid can affect laying hens and the nature of eggs, but more research is required to understand the influence of dietary inclusion level.

Key Words: Hen, Sinapic Acid, Aanola Meal

298 The use of natural antibiotic alternative and growth promoter feed additives and subsequent effects on broiler performance and carcass quality. N. P. Buchanan*[1], J. M. Hott[1], S. E. Cutlip[1], A. L. Rack[1], A. Asamer[2], and J. S. Moritz[1], [1]*West Virginia University*, *Morgantown*, [2]*Delacon International*, *Steyregg, Austria*.

The use of subtherapeutic levels of antibiotics in poultry feed improves performance and morbidity in broilers. However, consumer pressure has resulted in the development of natural feed additives that may also improve broiler performance and morbidity. Past research has shown that phytogenic feed additives containing essential oils, herbs, spices, and organic acids may enhance the production of gastric secretions, stimulate blood circulation, and accelerate cell osmosis of pathogenic bacteria. The objective of the current study was 1) to assess the use of Biostrong 505+ as a natural alternative to subtherapeutic antibiotics in broiler diets, 2) to assess the use of Biostrong 510 as a natural growth promoter and 3) to determine the effect of Biostrong 505+ and 510 on performance and carcass quality of broilers. One thousand three hundred forty four Cobb 500 broiler chicks were obtained from a commercial hatchery at 1 day of age. Three-phase feeding (starter, grower, finisher) was utilized for the 0-18, 19-30, and 31-40 day periods. Starter diets were fed as crumbles. Grower and finisher diets were fed as pellets. Broilers were reared on built-up litter. Experimental diets consisted of two diet formulations (Cobb maximum yield or least cost) arranged in a factorial design with two inclusions of either Biostrong 505+ (0 or 0.025%) or 510 (0 or 0.015%). The maximum yield diet improved live weight gain, feed conversion, carcass weight, and breast yield for broilers in the 505+ group (P≤0.05). The maximum yield diet improved carcass weight and breast yield for broilers in the 510 group (P≤0.05). Inclusion of either Biostrong 505+ or 510 improved feed conversion (P=0.0109, P=0.0438). In addition, the inclusion of Biostrong 505+ improved breast yield (P=0.0577). Biostrong 505+ or 510 may be viable natural alternatives to use of subtherapeutic antibiotics and growth promoters, respectively.

Key Words: Antibiotics, Phytogenic Feed Additive, Broilers

299 Evaluation of different additives in chicks challenged with necrotic enteritis. J. L. Shelton[1], A. R. Garcia[1], S. W. Davis[2], and D. W. Giesting*[1], [1]*Cargill Animal Nutrition*, *Elk River, MN*, [2]*Colorado Quality Research*, *Wellington, CO*.

Two experiments (EXP) were conducted at Colorado Quality Research to determine the effect of additives on growth in chicks challenged with Necrotic Enteritis (NE). Both EXP were conducted using floor pens and chicks were housed from hatching to 42 d. Initial and final body weight (BW) were 42 and 2,625 g for EXP 1 or 40 and 2,619 g for EXP 2. Feed intake and BW were measured weekly and chicks had ad libitum access to feed and water. Chicks were inoculated through the feed with coccidia (*E. acervulina*, *E. maxima*, and *E. tenella*) on d 9 and then with*Clostridium perfringens* on d 14 to d 16. Lesion scores (LS) were measured on d 16. Treatments included an unchallenged negative control (NC, no additives), a challenged NC, and a challenged positive control (virginiamycin, Vm). The additives tested in these EXP were *Bacillus* (B), a plant extract (PE), mannan oligosaccharide (M), a prebiotic added at a high (PREH) or a low (PREL) level. In EXP 1, d 21 BW was higher ($p < 0.05$) for chicks fed Vm or B+PREH and LS was lower ($p<0.05$) for chicks that were unchallenged or fed Vm, B+PREH, PE+M relative to the NC. Overall, chicks fed Vm, B+PREH, PE+M, or B+PE+M had lower ($p<0.05$) mortality relative to the NC. In EXP 2, different additive feeding programs were tested. They were: 1) feeding one level of additives for 42 d or 2) feeding one level of additives through the challenge period (d 21) and then a lower level for the remainder of the EXP. Chicks that were unchallenged or fed any of the test diets had reduced ($p < 0.05$) LS relative to those fed the NC. However, addition of Vm had no effect on growth. Overall, birds fed the 4-way combination of B+PE+PREL+M fed using feeding program 2 had increased ($p< 0.05$) gain:feed relative to the NC. Results from these trials indicate that combining additives with different modes of action could improve performance in chicks challenged with NE. Reducing the levels of additives after the starter period could be beneficial to chick performance and reduce additive costs.

Key Words: Chick, Necrotic Enteritis, Additives

300 Dietary *Bacillus subtilis* C-3102 spores influence intestinal (excreta) populations of Lactobacilli, *Clostridium perfringens*, Enterobacteriaceae (coliforms), and Salmonella, and live performance of broiler chickens. M. Kato[1], N. Otomo[1], K. Nishimura[2], Y. Tadano[3], T. Marubashi[3], H. Miyazaki[3], K. Maruta[3], and D. M. Hooge*[4], [1]*Calpis USA, Inc.*, *Schaumberg, IL*, [2]*Quality Tech. Int'l, Inc.*, *Elgin, IL*, [3]*Calpis Co. Ltd*, *Tokyo, Japan*, [4]*Hooge Consulting Service, Inc.*, *Eagle Mountain, UT*.

Intestinal Lactobacilli (Lac) counts and Lactobacilli/total anaerobes (Lac/TA%; 50% or more being optimal) are important in relationship to broiler performance and pathogen loads. CALSPORIN® (Calpis Co. Ltd, Tokyo, Japan) contains *Bacillus subtilis* C-3102 (Bs) aerobic spores which vegetate in digesta and consume oxygen causing proliferation of native colonizing, facultatively anaerobic Lactobacilli

to help improve bird performance and reduce pathogen loads. In Exp. 1 in southern Japan, Bs was added to all broiler feeds (0 or $3x10^5$ CFU/g), and excreta collected at 2 ages. At 14 d, in the Bs flock Lac increased ($P<0.05$) and Salmonella were not detected vs 4.97 Log10 CFU/g excreta in the negative control flock. At 49 d, *Clostridium perfringens* (3.22 vs 2.66 Log10 CFU/g excreta; $P<0.05$) and Salmonella (4.07 vs 3.31 Log10 CFU/g excreta, $P<0.01$; 20/20 vs 10/20, $P<0.05$) were reduced in the Bs flock. Two trials were conducted at a US broiler company to compare Bs fed flocks vs previous antibiotic growth promoter (AGP; for necrotic enteritis prevention) fed flocks. Excreta was collected at 35 d. In Exp. 2, Lac ($P<0.001$) and Lac/TA% (22.9% vs 52.2%; $P<0.05$) were higher and Enterobacteriaceae (coliforms) lower ($P<0.01$) in Bs birds. Livability was higher and farm condemnations lower in 7 Bs flocks vs 4 previous AGP flocks ($P<0.01$), and caloric conversion was lower in 7 Bs flocks vs 902 simultaneous flocks ($P=0.014$). In Exp. 3a, Lac ($P<0.001$) and Lac/TA% (21.2 vs 58.5%; $P<0.01$) were higher in Bs birds. In Exp. 3b (same control as Exp. 3a), Lac ($P<0.001$) and Lac/TA% (21.2% vs 54.8 and 59.5%; $P<0.001$) were higher and *Clostridium perfringens* lower ($P<0.05$) in Bs birds. The Bs C-3102 flocks had higher intestinal (excreta) Lac or Lac/TA%, lower pathogen counts, and/or improved performance, compared to simultaneous (or previous) negative control or AGP flocks.

Key Words: Bacillus Subtilis C-3102, Lactobacilli, Pathogens

301 Effect of synbiotic feed additive in comparison to antibiotic growth promoter on performance and health status of broilers. M. Mohnl*[1], Y. Acosta Aragón[1], A. Acosta Ojeda[2], B. Rodríguez Sánchez[2], and S. Pasteiner[1], [1]*BIOMIN GmbH*, *Herzogenburg, Austria*, [2]*Instituto de Ciencia Animal*, *San José de las Lajas La Habana, Cuba*.

The present trial was conducted to evaluate the efficacy of a synbiotic product in comparison to a commonly used AGP (antibiotic growth promoter) on broiler performance during a 42 day study. 525 one-day-old male chicks (Cuban hybrid EB 34) were randomly distributed to 3 experimental groups with 7 replicates per group and 25 animals per replicate. Experimental groups included a non-treated control group, a group which received a synbiotic product (Biomin® PoultryStar) via the drinking water on the first three days and for three consecutive days at each feed change and an AGP group which received Avilamycin (40 ppm) via the feed. The animals were fed a standard corn-soy ration in a three diet feeding program (starter (1- 14), grower (15- 28), finisher (29- 42)). Feed and water were provided at libitum. The birds were kept under observation for 42 days and performance parameters like body weight and feed intake were measured weekly. Furthermore daily weight gain and feed conversion ratio (FCR) were calculated. Clinical inspections and necropsies were conducted and mortality was registered daily. After 42 days body weight and FCR of birds which received the synbiotic product or the AGP were significantly higher ($P<0.05$) and feed intake was lower when compared to control group. Synbiotic group and AGP group increased body weight by 2.04% and 1.99% respectively in comparison to control. Mortality could be reduced in treatment groups in comparison to control (control group: 2.8%, synbiotic group: 0.9%, AGP group: 0.9%). In the present study the synbiotic product had a comparable potential to improve broiler performance as Avilamycin and might therefore be a promising alternative to the use of AGPs in broiler production.

Key Words: Synbiotic, Antibiotic Growth Promoter, Broiler Performance

Nonruminant Nutrition: Poultry Nutrition - Breeder and Laying Hen Nutrition and Broiler Environment

302 The effect of feed restriction programs and growth curves on reproductive performance, stress and metabolism in broiler breeder hens. M. de Beer*[1], J. P. McMurtry[2], D. M. Brocht[2], and C. N. Coon[3], [1]*Aviagen*, *Huntsville, AL*, [2]*USDA-ARS*, *Beltsville, MD*, [3]*University of Arkansas*, *Fayetteville*.

An experiment was conducted to compare everyday (ED) and skip-a-day (SK) feeding programs and early slow growth (SLOW) and broilerized (BROIL) treatments. Feed restriction programs were implemented from 4 weeks to 5 % production. The SLOW group was fed to reach 75 % of standard BW by 12 weeks, and then to reach standard BW by 21 weeks. The BROIL group was fed *ad libitum* till 7 weeks and then severely restricted to reach standard BW by 21 weeks. Parameters measured included BW, uniformity, age at sexual maturity (SM), total and settable egg production, body composition, liver size and composition, *in vitro* lipogenesis (IVL), metabolic hormone levels and heterophil to lymphocyte ratio (H/L). The trial period lasted 45 weeks. Birds fed ED grew more efficiently than SK or SLOW. The BROIL treatment had significantly worse feed utilization than all other groups. Frame size was consistently greater in BROIL pullets and consistently smaller in SLOW pullets. Birds fed ED reached SM before SK, who in turn reached SM before SLOW or BROIL birds. Egg production was significantly higher in ED than SK, which in turn was higher than either SLOW or BROIL. Liver weight and IVL was elevated in SK and SLOW pullets above ED pullets during rearing. Liver weight and IVL were lower in BROIL pullets than other groups during rearing, but after photostimulation dramatic increases in liver weight and IVL resulted in this trend being inverted by 27 weeks. As an indicator of stress, H/L ratios were elevated above ED pullets in SK, SLOW and BROIL pullets at various times during rearing. Corticosterone and T3 levels were elevated in SK and SLOW birds during rearing. IGF-1 was higher in ED than SK birds during rearing. Feeding regimens and growth curves have a major influence on efficiency, metabolism and reproductive performance in broiler breeders.

Key Words: Broiler Breeder, Growth Curve, Metabolism

303 Effects of feeding programs during rearing on carcass fatty acid profiles and serum α_1 acid glycoprotein levels in broiler breeder hens. M. de Beer*[1] and C. N. Coon[2], [1]*Aviagen Inc*, *Huntsville, AL*, [2]*University of Arkansas*, *Fayetteville*.

Skip-a-day feeding programs are widely employed during rearing to improve pullet uniformity. An experiment was conducted to determine the effect of everyday and skip-a-day feeding programs on fatty acid (FA) composition and serum α_1 acid glycoprotein (AGP) levels of broiler breeder hens. A total of 420 day old broiler females were randomly assigned to 12 pens at 35 chicks per pen. Chicks were full fed to 10 days, and then fed restricted amounts of feed everyday until 28 days. At 28 days, 6 randomly selected pens were changed to skip-a-day (SK) feeding while the other 6 were fed everyday (ED). The diet and total feed allocation was identical for both ED and SK pullets throughout the trial. At 20 weeks of age 8 pullets from each group were killed. All birds were fed ED after 25 weeks of age. At 40 weeks, a further 8 birds from each group were killed. Abdominal fat samples were obtained from each of the killed birds and analyzed for FA composition. Further, blood samples were obtained from 16 birds from each group at 40 weeks of age. Plasma samples were analyzed for AGP levels using a commercially available radial immuno-diffusion tray. Data was analyzed by ANOVA procedures using JMP 6.0 and means were separated using student's T-test. At 20 weeks SK birds had higher levels of C16:1 and C20:0 than ED birds. ED birds had higher levels of C18:2, C18:3, C20:2, C20:3 and C20:4. Mono-unsaturated FA levels were higher in SK birds while poly-unsaturated FA levels were higher in ED birds. By 40 weeks, C16:0 and C16:1 were marginally higher in SK birds while only C20:2 was still higher in ED birds. Serum AGP level did not differ between ED and SK hens at 40 weeks. However, serum AGP did correlate with both total egg production ($P<0.01$) and last 7 days egg production ($P<0.01$). In summary, SK feeding programs tend to increase the level of saturation of abdominal fat in broiler breeder hens. Serum AGP levels, while not affected by ED or SK feeding programs, do correlate strongly with egg production.

Key Words: Feeding Programs, Fatty Acids, Acute Phase Protein

304 Broiler and breeder feeding programs have different effects on the inflammatory response. A. Mireles Jr.* and S. Kim, *Foster Farms*, *Modesto, CA*.

The objective of this study was to compare the performance and acute phase response to E. coli lipopolysaccharide (LPS) of chicks fed a breeder or a broiler feeding program. The experimental design was a 2 feeding programs (Breeders vs. Broilers) X 2 Stress Levels (Control vs. LPS) with 25 chicks/treatment. Breeder diets were lower in protein and energy than broiler feeds. Birds were fed test feeds for 35 d. On 35 d, 50 chicks (25 Breeder + 25 Broiler) were injected 1 mg LPS/Kg body weight subcutaneously. Birds were euthanized 150 m post-injection. LPS stress increased spleen weight and body temperature, and it decreased serum Ca and N. Birds fed broiler were heavier ($P < 0.05$) than birds fed breeder feed (1.9 vs. 0.7 Kg). 150 m post-stress, relative body losses were larger ($P < 0.05$) for birds on breeder vs. broiler feed (6.63 vs. 4.87%). Liver weight of stressed Breeders was larger ($P < 0.05$) than that of Broilers (0.23 vs. -0.01%) and spleen weight was lower (0.11 vs 0.13%, $P < 0.05$). The febrile response was lower ($P < 0.05$) for Broilers vs. Breeders (0.2 vs. 0.9 C), and Breeders had higher ($P < 0.05$) levels of serum A-1 alpha glycoprotein than Broilers (365 vs. 306). Birds on broiler feed had higher ($P < 0.05$) serum Ca (92 vs 87) & total N (4764 vs 3856 PPM) than birds receiving breeder feeds. Compared to breeder feeds, broiler feeds down-regulate an inflammatory response.

Key Words: Acute Phase Response, Broilers, Breeders

305 Effect of the level of methionine, linoleic acid, and added fat in the diet on productive performance and egg quality of brown laying hens in late phase of production. H. M. Safaa[1,2], M. P. Serrano[1], D. G. Valencia[1], X. Arbe[3], R. Lázaro[1], and G. G. Mateos*[1], [1]*Universidad Politécnica de Madrid*, *Spain*, [2]*Cairo University*, *Egypt*, [3]*Cantos Blancos S.L.*, *Guadalajara, Spain*.

A total of 960 Lohmann Brown laying hens were used to study the effect of methionine (0.31 vs. 0.36%), linoleic acid (1.12 vs. 1.60%), and added fat (1.1 vs. 3.0%) level in the diet on productive performance and egg quality from 56 to 75 weeks of age. There were eight treatments arranged factorially (2 x 2 x 2) and six replicates of 20 hens per treatment. No interactions among main effects were detected and therefore, only main effects are presented. Few effects were observed among dietary treatments for body weight, daily feed intake, feed conversion ratio, egg production rate, egg weight, egg mass, and mortality rate. For the entire experiment, methionine level did not affect laying hen performance ($P > 0.10$). However, from 60 to 67 wk of age an increase in methionine from 0.31% to 0.36% increased the proportion of large eggs (> 63 g) from 79.8% to 85.9% ($P < 0.05$). Increasing the linoleic acid content of the diet from 1.12% to 1.60% did not modify any productive trait at any age ($P > 0.10$). Increasing the level of added fat from 1.1% to 3.0% increased the percentage of extra-large (> 73 g) eggs from 20.4 to 22.8% but the difference was not significant ($P > 0.10$). However, from 64 to 67 wk of age, an increase in fat content tended to increase the percentage of extra-large eggs ($P < 0.10$). Percentage of broken eggs, shell-less, and dirty eggs were not affected by treatment ($P > 0.10$). The Roche Color Fan score of eggs was higher in hens fed 3.0% added fat than in hens fed 1.1% added fat (12.5 vs. 11.8; $P < 0.05$). We conclude that laying hens, late in the production cycle, do not need more than 1.12% linoleic acid in the diet and that an increase in methionine and fat content may result in a slight increase in the commercial value of the eggs.

Key Words: Laying Hen, Linoleic Acid, Egg Quality

306 Performance and egg quality of laying hens fed diets containing different levels of total and digestible amino acids. D. E. Faria*, H. R. B. Souza, A. L. Santos, and P. W. Rizzoli, *University of Sao Paulo (FZEA/USP)*, *Pirassununga, SP, Brazil*.

This experiment was carried out to evaluate the performance and egg quality of laying hens fed diets containing different levels of total and digestible amino acids. A hundred ninety two Hy-Line Brown hens, 54 wk of age, were randomly distributed in a 2 x 4 factorial scheme: feed formulation criterion (total and digestible amino acids) and amino acid levels in the diet (100%, 95%, 90%, and 85% of the methionine, lysine and tryptophan requirements), totalizing eight treatments and five replicates of four birds each. Performance (feed intake, energy intake, egg production, egg weight, egg mass, and feed conversion) and egg quality (albumen percent, yolk percent, Haugh unit, shell percent, shell thickness, and specific gravity) characteristics were

evaluated. Egg production was influenced by the amino acid levels in the diet, showing significant positive linear response. There were interactions for egg mass and feed conversion where the best results were observed when digestible amino acids with 100% of the requirements were used. There were no effects of the treatments on feed intake, energy intake, egg weight, and on internal and external egg quality characteristics. It was concluded that the performance of laying hens can be improved when the diets are formulated based on digestible amino acids concept.

Key Words: Feed Formulation, Nutrition, Poultry

307 An examination of broiler energy need for ambient temperature dependent homeostasis, protein and fat accretion and effective caloric value. A. Beker* and R. G. Teeter, *Oklahoma State University*, *Stillwater*.

An experiment was conducted in calorimeter chambers to investigate energy and oxygen need for body weight homeostasis, efficiency of metabolizable energy (ME) use for maintenance, exponent needed to convert live body weight to metabolic weight for fed and fasted broilers, zone of thermoneutrality, efficiency of energy use for protein (K_p) and fat (K_f) accretion, as well as the effective caloric value (ECV) of ambient temperature. The study utilized 8 weight groups of Cobb x Cobb broilers housed under 3-5 ambient temperatures (AT) per weight grouping, consuming feed at 4 levels (0, 5, 10% of body weight (W), and adlib). Data indicated that energy (Kcal/$W^{0.75}$/d) and oxygen (l/$W^{0.75}$/d) need for homeostasis declined curve linearly per unit metabolic weight as weight increased from 0.09 to 1.95 $kg^{0.75}$. Results, however; were impacted by AT. Relative to birds consuming feed ad libitum, maintenance needs averaged 33% of consumption. The exponent, to linearize live body weight with heat production (HP) of birds fed to W homeostasis, was determined to be 0.758 with birds strictly housed at TN. Further, the exponent to linearize HP of fasted birds was 0.679. The zone of thermoneutrality, at body weight homeostasis, was inversely related to metabolic weight, expressed as: TN=32.64425-(5.91277*MWT) (R^2=0.99) and curvilinearly related to W as: TNMBR=32.6466-(94.4603*W)-(0.7660*W^2) ;(R^2=0.99). Proportional differences in protein and fat accretion were utilized, along with efficiency of retained energy, to estimate K_p and K_f as simultaneous equations. Efficiency of accretion for energy use above maintenance was estimated as 78.7% for lipid and 67.6% for protein. Values for K_p and K_f using regression analysis were found unreasonable, presumably due to co-linearity between intake and accretion variables. The ECV of AT, quantified as a multiple of bird maintenance energy need was found to fall between 1 to 3 % of maintenance energy per Kg body weight.

Key Words: Broiler, ECV, Homeostasis

308 Antibiotic + electrolyte intervention minimizes damage in broiler performance during abrupt severe heat stress. A. Mireles Jr.* and S. Kim, *Foster Farms*, *Modesto, CA*.

Gut bacteria likely have a role during heat stress through an inflammatory reaction. The objective of this study was to examine the effect of antibiotics and electrolytes (OTC) in the water of heat stressed battery chicks at 3 ages. The experimental design was a 3 age (36, 25, and 15 d) X 2 water (Control, + OTC) X 2 heat stress (Control, Heat Stressed) factorial, with 5 replicate cages each. An attempt was made to maintain similar stock densities. All birds were raised in cages for the first 14 days. OTC water was introduced at the time of stress. Control room temperature was 25.6 - 26.7°C. Heat stressed room was increased 2.2°C/hour to 37.8°C and cycled back for 2 days. Weight gain was affected by age, heat stress, water, and interactions ($P < 0.05$). 15 and 25 d chicks were not affected by heat or water. 36 d heat stressed chicks on control water lost 227 g in 2 days ($P < 0.05$) compared to heat stressed on OTC or non-stressed chicks. During heat stress, total serum N and serum Ca increased (0.46 vs. 0.48%; 101 vs 107 PPM, $P < 0.05$). OTC decreased ($P < 0.05$) total N in all 36 d birds (0.47 and 0.52% vs. 0.45 and 0.50%) and increased ($P < 0.05$) serum Ca (95 and 108 vs. 102 and 110 ppm). Serum pH was inversely related to serum Ca (R^2=0.24, $P < 0.05$). Water treatment can minimize damage in 36 d old broilers caused by abrupt heat stress.

Key Words: Heat Stress, Antibiotics, Gut Microflora

309 Dietary salt combinations for broiler chickens under subtropical summer conditions: Live performance, carcass, and blood responses. T. Mushtaq*[1], H. Nawaz[1], M. A. Mirza[1], M. Athar[2], M. M. H. Mushtaq[1], G. Ahmad[3,1], and U. Noreen[1], [1]*University of Agriculture*, *Faisalabad, Pakistan*, [2]*Hi-Tech Feeds*, *Lahore, Pakistan*, [3]*Shamim Feed Industries*, *Bahawalpur, Pakistan*.

The study was planned to investigate the best combination of Sodium (Na), potassium (K) and chloride (Cl) keeping the dietary electrolyte balance (DEB) at 250 mEq/kg. The desired dietary Na, K and Cl levels were adjusted by incorporating sodium bicarbonate ($NaHCO_3$), sodium chloride (NaCl), calcium chloride ($CaCl_2$), potassium chloride (KCl), ammonium chloride (NH_4Cl) and potassium sulphate (K_2SO_4). A total of 270 Male Starbro from grantparent flock was obtained and kept on 27 floor pens on new softwood shave litter up to 42 d of age in a completely randomised design. Nine (9) treatments varying in their Na, K and Cl contents were formulated using stochastic formulation method at 95% level of confidence and were offered to 3 replicates having 10 birds each. The minimum and maximum temperatures recorded were 31.1 and 38.4°C respectively with RH 56%. Diet containing Na=0.30%, K=0.80% and Cl=0.30% (with $NaHCO_3$ 0.42%, NH_4Cl 0.20%, $CaCl_2$ 0.19%, K_2SO_4 0.04%) significantly improved body weight gain at 28 d. No significant effect of treatments was found on water consumption and mortality. A significant correlation (r=0.34) was observed between water intake and dietary Na. Water intake significantly improved FCR (r=-0.30) and weight gain (r=0.56) and lowered rectal temperature (r=-0.35). However, mEq ratio of K: Na of 2.4 and K: Cl of 2.0-2.5 significantly lowered mortality and serum bicarbonate contents. The diets with low Na (0.20%) and high K (1.08 or 1.19%) and Cl (0.40 or 0.50%) held mortality to 0% during the final week of age, compared to other diets. In conclusion, in heat stress the diet with 0.30% Na, 0.80% K and 0.30% Cl containing 0.19% $CaCl_2$, 0.04% K_2SO_4,0.42% $NaHCO_3$, and 0.20% NH_4Cl gave highest BWG 0-28 d (1,033 g) whereas the lowest FCR value of 1.71 was obtained.

Key Words: Dietary Electrolyte Balance, Broiler, Heat Stress

310 Response of growing broilers to digestible lysine and metabolizable energy levels in heat stress. G. Ahmad[1,2], T.

Mushtaq*[1], M. A. Mirza[1], and T. Ahmad[3], [1]*University of Agriculture*, *Faisalabad, Pakistan*, [2]*Shamim Feed Industries*, *Bahawalpur, Pakistan*, [3]*University of Arid Agriculture*, *Rawalpindi, Pakistan*.

The study was conducted to evaluate the response of heat stressed broilers to dietary digestible lysine (digestible Lys) and metabolizable energy (ME) during 14 to 35 d of age. Two levels of digestible Lys (0.8 and 1.0% with ideal protein concept) were used with 4 levels of ME (2.600, 2.700, 2.800 and 2.900 Mcal/kg) in 2 × 4 factorial arrangement. The average minimum and maximum temperature during the experiment was 27.7 and 41.3°C, respectively. Body weight gain (BWG) during the experiment was significantly (P≤0.005) affect by the digestible Lys × ME. The lowest BWG was observed when 0.8% digestible Lys was used with 2.900 Mcal of ME/kg. The feed intake was lower (P≤0.046) in high ME diets i.e., 2.800 and 2.900 Mcal/kg. The total digestible Lys intake during the experiment was significantly high (P≤0.001) for the birds fed on 1.0% digestible Lys as compared to that of 0.80% (14.48 vs. 11.89 g) with its significantly lower (P≤0.001) efficiency for weight gain (49.5 vs. 42.3). No significant effect of digestible Lys, ME or their interaction was observed on feed:gain, mortality, ME intake or ME efficiency for BWG.

Key Words: Metabolizable Energy, Digestible Lysine, Heat Stress

311 The effects of dietary supplementation of L-Carnitine on egg production traits of white leghorns. W. Zhai*[1], S. L. Neuman[2], M. A. Latour[1], and P. Y. Hester[1], [1]*Purdue University*, *West Lafayette, IN*, [2]*Guidant Corporation*, *St. Paul, MN*.

An earlier study in our lab has shown that yolk sac weights of progeny hatched from eggs of hens consuming 125 ppm L-carnitine were smaller than controls suggesting that carnitine improved the utilization of yolk fat by developing embryos. In addition, samples of yolks had 16.3 vs. 12.7 nanomoles of carnitine per gram of yolk in hens consuming carnitine as compared to controls, respectively (SEM=0.3, P=0.001). The effects of carnitine consumption on egg production traits are unknown; therefore, the current study determined if supplemental L-carnitine in White Leghorn diets affected egg production and egg traits. Diets were formulated to contain 0 or 125 ppm carnitine (analyzed values were 1 and 143 ppm, respectively). Diets were fed to birds beginning at hatch until 37 wk of age. Birds were transferred from pullet rearing cages to laying cages at 17 wk of age. Four hens were housed in each laying cage providing 549 sq cm/bird. Numbers of egg laid per cage were recorded daily and hen-day egg production was calculated monthly. Egg and shell traits were determined every 4 wk when the hens were 23, 27, 31, and 35 wk of age. Data were analyzed using ANOVA with repeated measurements using the mixed model procedure of SAS. Hens consuming carnitine as compared to controls had similar egg production (84 and 86%, SEM=1, P=0.30), egg weight (53.6 and 53.6 g, SEM=0.3, P=0.88), yolk weight (13.7 and 13.7 g, SEM=0.1, P=0.89), relative yolk weight (yolk weight/egg weight, 25.5% and 25.4%, SEM=0.1, P=0.54), shell weight (4.85 and 4.85 g, SEM = 0.04, P=0.96), relative shell weight (shell weight/egg weight, 9.07 and 9.06%, SEM=0.05, P=0.83), and shell thickness (0.358 and 0.358 mm, SEM=0.002, P=0.87), respectively. It is concluded that consumption of L-carnitine from hatch to 37 wk of age had no effect on egg production and egg traits.

Key Words: Carnitine, Egg Production, Yolk Weight

312 Effects of corn particle size in a corn-soybean meal diet on chick growth performance and nutrient digestibility. C. M. Jacobs*, P. L. Utterback, and C. M. Parsons, *University of Illinois*, *Urbana*.

Two experiments were conducted to evaluate the effects of corn particle size in a 23% CP corn-soybean meal diet when fed to young chicks. The first experiment was performed using New Hampshire x Columbian female chicks and the second experiment used Ross x Ross commercial male chicks. In both experiments, day old chicks were randomly assigned to one of four dietary treatments consisting of corns that were ground in a hammer mill using the following screen sizes: 1/16-in. (1.59mm) ground corn, 3/16-in. (4.76mm) ground corn, 5/16-in. (7.94mm) ground corn, or 6/16-in. (9.52mm) ground corn. Chicks were fed the experimental diets from 0-21 days post hatch. Growth performance, gizzard weight, and gizzard pH were measured in both experiments, and ME_n and apparent amino acid digestibility were determined at 7 and 21 days of age in the first experiment. When compared to the 1/16-in, ground corn, feeding the larger particle sizes had no significant (P>0.05) effect on growth performance in either experiment. Feeding larger particle sizes caused an increase in relative gizzard weight (% of body weight) in both experiments, with the greatest increase occurring with the 6/16-in. ground corn. Gizzard pH in both experiments was unaffected by corn particle size. Corn particle size also had no significant (P>0.05) effect on ME_n and amino acid digestibility values. There was, however, an age effect on amino acid digestibility and ME_n. Digestibility coefficients for most amino acids were higher (P>0.05) at 21 days than at 7 days for all dietary treatments. The ME_n values also increased (P<0.05) from 7 to 21 days for the 3/16-in. and 5/16-in. corn treatments. The results of this study indicate that feeding larger particle size corn increases relative gizzard weight and has no significant effect on growth performance, ME_n, and amino acid digestibility.

Key Words: Corn Particle Size, Growth Performance, Nutrient Digestibility

313 Changes in zebra finch (*Taeniopygia guttata*) eggshell morphology after oral estrogen exposure as chicks. S. L. Westmoreland*[1], H. Pourarsalan[1], D. H. Hawkins[3], J. R. Rochester[2], and J. R. Millam[2], [1]*The University of Texas at Arlington, Department of Biology and The Center for Electron Microscopy*, *Arlington*, [2]*The University of California, Department of Animal Science*, *Davis*, [3]*The University of Texas at Arlington, Department of Mathematics*, *Arlington*.

Environmental estrogens have been implicated in changes in the reproductive performance, song systems, oviduct histology, egg production, and shell breakage in Zebra Finch birds (*Taeniopygia guttata*); we investigated the relationship of estradiol benzoate (EB) to eggshell thickness and morphology. Zebra Finch birds from a breeding colony at The University of California at Davis were fed a mixed seed diet and water *ad libitum* and kept on a 16L: 8D photoschedule. Female chicks were treated for 7 days, from post-hatch days 5-11, with either orally administered estradiol benzoate in canola oil or canola oil alone (control) at 1 microliter/g body weight. (EB was 100 nmol/g body weight); males were treated only with canola oil. At approximately 110 days of age, 5 males and 5 females at a time were moved to a communal cage and provided with nest boxes and nest material to stimulate pair-formation and breeding. They were then removed to individual breeding cages, where eggs were collected. The 25 eggs for this study included 15 eggs from control females and 10 eggs from EB-treated females; all eggs were the second egg laid in the clutch. On the day of collection eggs were split open at the equator, emptied, rinsed with deionized water, and air dried. Three samples were taken from each egg at the equator region and were placed on aluminum stubs. The samples were oriented for a radial (cross section) view of the shell. Stubs were coated with gold and palladium and viewed using scanning electron microscopy. Digital micrographs were made for all shell samples at 500X. Micrographs of shell cross sections were analyzed for shell thickness using Image Pro Plus computer software. These data were statistically analyzed using SAS. The experimental shells were found to be significantly thinner than the control shells ($p = 0.02$, experimental mean = 70.45 µm, control mean = 76.90 µm, SE = 2.58). Future studies will include analysis of shell structure to determine the relationship of shell features to shell thickness and to determine the underlying physiology of shell formation and how it is impacted by estrogen exposure.

Key Words: Avian Eggshell, Estrogen, Endocrine Disruptor

314 Comparison of oral vs. injected dosing of the soy phytoestrogen genistein on the reproductive development of female broiler chicks. L. M. Stevenson*, C. R. James, S. S. Oates, J. B. Hess, and W. D. Berry, *Auburn University*, *Auburn, AL*.

Developmentally inappropriate exposures to estrogenic compounds are known to alter morphology and function of the reproductive tract in various species. Chickens are continually exposed to the relatively potent estrogenic soy isoflavones through the diet. Previous experiments in this laboratory have demonstrated that the primary soy isoflavone genistein induces proliferation of the chick oviduct. However, information is lacking as to specific reproductive tract developmental effects of genistein exposure in chicks. Experiments were done to compare the effects of oral exposure and injected exposure to genistein. The oral and injected effects of genistein were also compared to a classical estrogen, diethylstilbestrol (DES). To avoid the effects of dietary soy isoflavones, the experimental diets were formulated with dried egg white as a protein source. Day old female chicks were assigned to treatments: egg white based diet with daily oral gavage or subcutaneous injection of sesame oil vehicle (CV); 1mg diethylstilbestrol (DES); 10mg genistein (G10) or 40mg genistein (G40). There was also a treatment fed a standard starter diet with daily oral gavage or subcutaneous injection of sesame oil vehicle (SV). At 15 days of age, the injected treatments increased the absolute oviduct weight and oviduct weight as a percentage of final body weight as compared to the oral treatments ($P<0.05$). The DES treatments, both oral and injected, increased the absolute oviduct weight and oviduct weight as a percentage of final body weight as compared to all other treatments ($P<0.05$). The injected treatments of G40 and DES showed adult hen behaviors, marked development the right oviduct, and increased the absolute oviduct weight and oviduct weight as a percentage of final body weight as compared to the CV and SV treatments ($P<0.05$). The injected DES treatment showed partially developed right oviducts. The injected G40 treatment showed membranous cystic right oviducts. It was concluded that injected doses of genistein elicit a stronger estrogenic response in the developing female chick as compared to oral doses.

Key Words: Genistein, Oviduct, Phytoestrogen

315 Analysis of plasma serotonin levels and hemodynamic responses following chronic serotonin infusion in broilers challenged with bacterial lipopolysaccharide and microparticles. M. E. Chapman*[1], R. L. Taylor[2], and R. F. Wideman[1], [1]*University of Arkansas*, *Fayetteville*, [2]*University of New Hampshire*, *Durham*.

There has been much interest in the role of serotonin (5-hydoxytrytamine, 5-HT) in the pathogenesis of pulmonary hypertension due to episodes of pulmonary arterial hypertension (PAH) in humans linked to serotoninergic appetite suppressant drugs. In this study, we investigated the role of serotonin in the development of pulmonary hypertension induced by intravenously injecting bacterial lipopolysaccharide (LPS, endotoxin) and cellulose microparticles. In experiment 1 we employed a 5-HT ELISA kit for the in-vitro quantitative determination of 5-HT in plasma during the development of pulmonary hypertension induced by injecting 1 mg LPS and 0.35 mL cellulose microparticles suspended at 0.02 g/mL in saline i.v. in broilers (n = 240). In experiment 2 broilers were either chronically infused with 5-HT (10 mg/mL) via surgically implanted osmotic pumps designed to deliver 5 µL/hr for 14 d or received sham surgery as a control (n = 40). After a period of 10 d, the pulmonary arterial pressure (PAP) was recorded during challenge with injected LPS or microparticles. Microparticles elicited plasma levels of 5-HT more than two-fold higher than those elicited by LPS from 15-45 min post injection($P \leq 0.05$). This indicates that 5-HT is an important mediator in the pulmonary hypertensive response of broilers to microparticles, but 5-HT may not play a prominent role in the pulmonary hypertensive response to LPS. Furthermore, chronic 5-HT infusion via osmotic pumps caused an increase in the duration of the pulmonary hypertensive response of broilers to microparticles indicating that the infused 5-HT was sequestered by circulating thrombocytes and then released upon

microparticle mediated thrombocyte activation. Serotonin appears to play a less prominent role in the pulmonary hypertensive response of broilers to LPS indicating that other mediators within the innate response to inflammatory stimuli may also be involved. These results are consistent with our hypothesis that PAH ensues when vasoconstictors such as 5-HT overwhelm the dilatory affects of vasodilators such as nitric oxide (NO), thereby effectively reducing the pulmonary vascular capacity of PAH-susceptible broilers.

Key Words: Hypertension, Broiler, Serotonin

316 Chicken visfatin: The leaner side of an adipokine. S. M. Krzysik-Walker*, O. M. Ocón-Grove, S. R. Maddineni, G. L. Hendricks III, and R. Ramachandran, *The Pennsylvania State University*, *University Park*.

The adipokine visfatin (VFN), also known as pre-B-cell colony-enhancing factor 1, has been shown in mammals to be preferentially secreted by visceral fat, and elicits insulin-mimetic effects on glucose metabolism. Increased visceral fat and hyperglycemia have been correlated with higher plasma VFN levels in mammals. However, the expression of VFN in chickens, a naturally occurring hyperglycemic model, has not yet been described. The objective of the present study was to determine the level of VFN gene expression in the primary metabolic tissues, adipose, liver, and skeletal muscle, as well as to determine how this expression is altered with age in male broilers. We hypothesized that VFN gene expression in broiler chickens would be greatest in the abdominal fat pad and would change with age and/or fat accretion. Using RT-PCR and western blotting, we detected VFN mRNA and protein, respectively, in adipose, liver and skeletal muscle of male broilers. Further analysis with real-time quantitative PCR revealed that skeletal muscle had significantly greater amounts of VFN mRNA ($P<0.05$; n=5) compared with adipose and liver. To determine the influence of body composition and adiposity on VFN mRNA expression, adipose, liver and skeletal muscle were collected from 4 week and 8 week old male broilers. Quantification of VFN mRNA revealed significantly greater expression in skeletal muscle, regardless of age, with the greatest level being found in 8 week old broilers ($P<0.05$; n=5). No significant difference, however, was found in blood glucose levels at either age. Collectively, these findings indicate that skeletal muscle is one of the primary sources of VFN in chickens, in contrast to mammals where VFN is primarily expressed in visceral adipose tissue. Our data indicates that skeletal muscle VFN gene expression may be influenced by body composition and fat accretion. We propose that VFN is involved in regulating energy metabolism in broiler chickens.

Key Words: Visfatin, PBEF1, Adipokine

317 Transpulmonary pressure gradient verifies pulmonary hypertension is initiated by increased arterial resistance in broilers. A. G. Lorenzoni*, R. F. Wideman, and N. B. Anthony, *University of Arkansas*, *Fayetteville*.

Previous hemodynamic evaluations demonstrated that pulmonary arterial pressure (PAP) is higher in broilers that are susceptible to pulmonary hypertension syndrome (PHS, ascites) than in broilers that are resistant to PHS. We compared key pulmonary hemodynamic parameters in broilers from PHS-susceptible and PHS-resistant lines (selected under hypobaric hypoxia), and in broilers from a relaxed (control) line. Data were compared using one-way ANOVA by group/anatomical segment to compare data between and within lines, respectively. In experiment 1 the PAP was measured in male broilers in which a flow probe positioned on one pulmonary artery permitted the determination of cardiac output (CO) and pulmonary vascular resistance (PVR). The PAP and relative PVR were higher in the susceptible (34.3 ± 2.3 mm Hg and 0.11 ± 0.01 resistance units, ru) than in relaxed (22.4 ± 1.4 mm Hg and 0.08 ± 0.01 ru) and resistant broilers (24.4 ± 1.1 mm Hg and 0.08 ± 0.01 ru), whereas CO did not differ between lines. In experiment 2 male and female broilers from the three lines were catheterized to measure pressures in the wing vein, right atrium, right ventricle, pulmonary artery and pulmonary veins (WP, wedge pressure). The transpulmonary pressure gradient (TPG) was calculated as (PAP-WP), with PAP quantifying precapillary pressure and WP approximating post-capillary pulmonary venous pressure. When compared with resistant and relaxed broilers, PAP values in susceptible broilers were >10 mm Hg higher, TPG values were >8 mm Hg higher, and WP values were <2 mm Hg higher, regardless of sex. The combined hemodynamic criteria (elevated PAP and PVR combined with a proportionally elevated TPG) demonstrate that susceptibility to PHS can be attributed primarily to pulmonary arterial hypertension associated with increased pre-capillary (arteriole) resistance rather than to pulmonary venous hypertension caused by elevated post-capillary (venous and left atrial) resistance.

Key Words: Broiler, Pulmonary Arterial Hypertension, Transpulmonary Pressure Gradient

318 Cloning and characterization of chicken nucleobindin-2 (NUCB2) cDNA: The precursor for a putative anorexigenic peptide, nesfatin-1. P. K. Selvan*, G. L. Hendricks III, S. R. Maddineni, S. M. Krzysik-Walker, O. M. Ocón-Grove, and R. Ramachandran, *The Pennsylvania State University*, *University Park*.

Nucleobindin-2 (NUCB2) is a secreted protein that regulates intracellular Ca2+ and promotes bone maturation in mammals. Recently, NUCB2 has been characterized as a precursor molecule for three peptides (nesfatin 1-3), of which nesfatin-1 has been shown to suppress feed intake in rats through a leptin-independent melanocortin signaling pathway in the hypothalamus. However, a chicken homologue of NUCB2 has not been previously described. The objectives of the present study are to clone NUCB2 cDNA, characterize the deduced protein sequence for identifying nesfatin 1-3, and quantify NUCB2 gene expression in the diencephalon and adipose tissue in male broiler and leghorn chickens. Using RT-PCR, we found that NUCB2 mRNA is expressed in broiler diencephalon, myocardium, pituitary gland, skeletal muscle, liver, spleen, kidney, testes, and adipose tissue. For further characterization, we cloned and sequenced the full-length NUCB2 cDNA from broiler adipose tissue and found its deduced amino acid sequence to be 76.7% similar to human NUCB2 protein. The chicken NUCB2 protein sequence contained three cleavage sites, similar to human NUCB2 protein that may yield nesfatin 1-3. The putative chicken nesfatin-1 and nesfatin-2 amino acid sequences are 78% and 85% similar to that of rat, respectively. Using real-time quantitative PCR, significantly greater NUCB2 mRNA quantities were found in the abdominal fat of 8 week-old male broilers compared with male leghorns ($P<0.05$; n=4). No significant difference, however, was found in NUCB2 mRNA quantity in the diencephalon of broiler versus leghorn chickens. Based on these findings, we conclude that the

NUCB2 is expressed in multiple chicken tissues, which may possibly yield nesfatin as in mammals, and that NUCB2 gene expression is influenced by fat accretion in the adipose tissue. However, a physiological role of NUCB2 or nesfatin on feed intake in broilers remains to be studied.

Key Words: Nucleobindin, Nesfatin, Broiler

319 Gene expression in the lateral septal organ, mediobasal hypothalamus and septal-pituitary-gonadal axis following activation of the photoneuroendocrine system. H. Li*[1], J. A. Proudman[2], S. Jin[1], and W. J. Kuenzel[1], [1]*University of Arkansas*, *Fayetteville*, [2]*USDA/ARS/BGL*, *Beltsville, MD*.

Long day stimulation releases gonadotropin-releasing hormone (GnRH-1), gonadotropins, and induces testes growth in some wild and domestic avian species. Encephalic photoreceptors (EPRs) have been posited to detect photoperiodic changes. Two distinct groups of cerebrospinal fluid contacting neurons (CSFcn) residing in the mediobasal hypothalamus (MBH) and lateral septal organ (LSO) have been proposed to serve as EPRs with the former site thought to be the most likely candidate due to the presence of clock genes shown in quail. The current study examined possible roles for both the MBH and LSO in the avian photoneuroendocrine system. The hypothesis tested was that brain areas first showing expression for genes associated with photoreceptors should be the most likely region/s for housing EPRs. Gene expression profiles analyzed included vasoactive intestinal polypeptide (VIP), phosphodiesterase (PDE), type II deiodinase (D2), GnRH-1 and gonadotropins. Sulfamethazine (SMZ) mixed in the feed at 0.2% plus a long-day photoperiod was utilized to stimulate rapid gonadal development. Real time qRT-PCR (SYBR Green or TaqMan) was used to quantitate mRNA transcripts. SMZ augmented and temporally advanced the stimulatory effects of long day on gene expression of VIP, PDE, and GnRH-1. The first elevated expression of genes occurred in the LSO including VIP at 4h and PDE at 6h, followed by GnRH-1 in the bed nucleus of the pallial commissure (NCPa) at 4-8h after SMZ administration. Treatment of SMZ had no effect on VIP gene expression in the MBH within the first 8h. The long day treatment stimulated VIP gene expression at 12h in the LSO and MBH, GnRH-1 in the NCPa and D2 in the MBH. Taken together, the current study suggests that the LSO contains neurons displaying the earliest gene expression characteristic of EPRs and is followed by a neuroendocrine cascade responsible for rapid gonadal development.

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Key Words: Encephalic Photoreceptors, Sulfamethazine, Chicks

320 Study of the effects of blindness on sexual maturation in Smoky Joe roosters. J. Perttula* and G. Bedecarrats, *University of Guelph*, *Guelph, ON, Canada*.

In domestic chickens, sexual maturation is generally induced by increasing the photoperiod. Stimulation of hypothalamic photoreceptors triggers the secretion of gonadotropin releasing hormone which in turn induces the synthesis and release of gonadotropins by the pituitary gland. Increasing levels of gonadotropins then stimulate the development and maturation of the gonads. In addition to this stimulatory axis, it has recently been proposed that an inhibitory pathway involving melatonin produced by the retina and pineal gland may exist. Using a genetically blind line of chickens, we previously showed that the lack of retinal stimulation advances egg-laying in hens. To determine if blindness also influences sexual maturation in males, 54 Smoky Joe roosters (24 blinds and 30 sighted) were raised under an 8 h photoperiod until 17 weeks of age, then stimulated with a 14 h photoperiod. At 14, 17, 18, 19, 21, and 23 weeks of age, 4 blind and 5 sighted birds were sacrificed, body weight as well as comb length were measured, and blood and various tissue were collected. Relative testicular weight was then calculated and total testosterone concentrations were measured in plasma by ELISA. With the exception of week 21, no difference in body weight was observed between blind and sighted roosters or between collection dates. In blind birds, comb length significantly increased between 14 and 17 weeks of age ($p<0.001$) while growth was more gradual in sighted ones. Similarly, testes were significantly larger in blind than sighted roosters at 17 weeks of age (sighted: 2.92 +/- 0.58% of body weight ; blind: 6.43 +/- 1.43%; $p<0.05$). However, following photostimulation, no significant difference could be observed. Interestingly, no significant difference in testosterone plasma concentration was observed between blind and sighted roosters or between collection dates. However, this could be explained by the small number of individuals used and the large standard deviations obtained. In conclusion, our study shows that blindness advances sexual development in roosters before photostimulation. In addition, these results suggest that signals originating from the retina may inhibit the reproductive axis in normally sighted birds.

Key Words: Blindness, Rooster, Reproduction

321 Dopamine-melatonin neurons in the turkey hypothalamus controlling seasonal reproduction. S. Kang*, A. Thayananuphat, T. Bakken, and M. El Halawani, *University of Minnesota, St Paul*.

The neural and neurochemical substrate mediating the reproductive photoperiodic time measurement (PTM) in birds has not been definitively established. Our previous studies have shown that a 30 min light pulse induced c-fos mRNA expression in dopamine (DA) neurons within the premammillary nucleus (PMM) of the turkey caudal hypothalamus, as well as in GnRH-I neurons of the anterior hypothalamic/pre-optic area, where GnRH-I mRNA was also found. Double-label immunocytochemistry (ICC) showed these PMM neurons to be immunoreactive (ir) to both tyrosine hydroxylase (TH; the rate limiting enzyme in DA biosynthesis) and melatonin (MEL). Moreover, the intensity of MEL staining appeared greater in brain sections obtained during night than day. We have shown that mRNA expression of TH and tryptophan hydroxylase 1 (TPH1; the first enzyme in MEL biosynthesis), cycle rhythmically and with opposite phases in the PMM neurons of birds kept under a diurnal illumination cycle (12-h light: 12-h dark; LD). These neurons can generate 24 hr TH and TPH1 mRNA expression rhythms in constant light (LL) and constant dark (DD). In addition, the expression patterns and amplitudes of TH and TPH1 mRNAs were different between long and short photoperiods. It is suggested that endogenous oscillators within PMM neurons appear to be important in regulating the DA and MEL rhythms which are required to drive the circadian system controlling reproductive seasonality in turkeys.

USDA # 2004-35203-14771

Key Words: Dopamine Melatonin, Avian Photoperiod, Seasonal Reproduction

322 Lipoic acid-induced changes in food intake in chickens. D. M. Denbow* and P. B. Siegel, *Virginia Polytechnic Institute and State University*, *Blacksburg*.

The enzyme AMP-activated protein kinase (AMPK) is believed to serve as an ″fuel gauge″ monitoring the energy level in the body. It may function both within and outside the central nervous system. Using a line of chickens selected for either low- or high-eight week body weight, we investigated whether altering the activity of this enzyme affected food intake, and whether genetic selection for high or low body weight altered the effect of lipoic acid. Lipoic acid is known to inhibit AMPK. Therefore, lipoic acid was injected either intraperitoneally (IP) or intracerebroventricularly (ICV) to determine its effect on food intake in both lines of birds. Food intake was monitored for 3 or 24 hours postinjection following ICV or IP injections, respectively. The ICV injection of 0, 12, 24 or 48 μg lipoic acid dose-dependently increased ($P<0.05$) food intake in 7 week-old high weight male birds while having no effect in 15 week-old low weight male birds. The IP injection of 0, 50, or 100 mg/kg BW of lipoic acid decreased ($P<0.05$) food intake in 11-15 week-old males of both lines. Therefore, altering AMPK activity can affect food intake in chickens.

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Key Words: AMP-Activated Protein Kinase

323 Clock gene expression in the premammillary nucleus (PMM) and the pineal gland of turkey hens. B. Leclerc*[1], S. Kang[1], A. Thayananuphat[1], C. Howell[1], S. Kosonsiriluk[2], Y. Chaiseha[2], and M. E. El Halawani[1], [1]*University of Minnesota*, *St. Paul*, [2]*Suranaree University of Technology*, *Thailand*.

Recent findings from our laboratory have implicated the PMM as a site of putative photoreceptive neurons. These neurons are shown to express both dopamine (DA) and melatonin (MEL), with DAergic activity up regulated during the light phase and MELergic activity during the dark phase of the light-dark illumination cycle. Theses neurons reach threshold activation (as indicated by c-fos mRNA expression) when a light period is provided during the photosensitive phase (14hr after light on). And, this is coincided with the activation of gonadotropic releasing hormone-I (GnRH-I) and the upregulation of GnRH-I mRNA expression. It is hypothesized that PMM DA-MEL neurons may be a component of a biological clock involved in reproductive photoperiodic time measurement (PTM), controlling seasonal reproduction in turkeys. In this study we cloned turkey's clock genes including Clock, Per2, Per3, Bmal1, Cry1 and Cry2 and examined their expression in the PMM which was compared to that expressed by the pineal gland. Turkey hens maintained on short photoperiod (6L:18D) were subjected to a 30 min light pulse at circadian times (CT) 8, 14 and 20. Tissues were collected 30 min, 1 hour and 3 hours following the onset of the light pulse. In the pineal gland, Per2 mRNA expression level was highest followed by mRNA expression of Cry1, Cry2, Per3, Clock and Bmal1. However, Per2 gene was not significantly modulated by light (one-way ANOVA; $P>0.05$) across all CTs. The expression of Per2, Cry1 and Cry2 genes was also examined in the PMM of turkeys following the 30 min light exposure. The expression of Cry1 and Per3 transcripts was enhanced 2-3 fold by the 1 hour light pulse at CT14 and CT20 and both were statistically significant by the ANOVA ($P<0.05$) and confirmed by the Tukey-Kramer test. It is not clear at this time whether clock genes are involved in mediating photic information to the reproductive neuroendocrine system of turkeys.

USDA# 2004-35203-14771

Key Words: Clock Genes, Turkey, Hypothalamus

324 The expression patterns of HIF 1α, HYOU1, HO1, and cTnT during embryonic development in the chicken heart. S. Druyan*[1], A. Cahaner[2], and C. M. Ashwell[1], [1]*North Carolina State University*, *Raleigh*, [2]*Hebrew University*, *Rehovot, Israel*.

Oxygen is one of the critical determinants of appropriate embryonic and fetal development including cardiogenesis. When tissues demand for oxygen exceeds oxygen supply, hypoxic conditions develop. In the developing embryo, hypoxia is associated with increased fetal mortality, cerebrovascular anomalies, cardiovascular dysfunction and altered angiogenesis. In this study 4 genes: hypoxia inducing factor subunit a - 1 (HIF 1α), hypoxia up regulated protein 1 (HYOU1) also known as ORP150, heme oxygenase 1 (HO1) and cardiac troponin T (cTnT) , were examined in the embryonic heart of the chicken to determine the expression patterns throughout development. The effect of embryonic age on gene expression was determined by real-time quantitative PCR normalizing to the level of GAPDH. On embryonic day 7 (E7) all three hypoxic induced genes were expressed at their highest levels evaluated, likely due to the fact that the yolk sac is the principal gas exchange organ and the origin of the primitive red blood cells. All three hypoxic induced genes expression significantly decreased from d E7 to E19 (internal pipping) followed by a significant increase in expression between internal pipping and external pipping (E20). During this period a gradual hypoxia and hypercapnia develop due to the decline in the allantois gas exchange the embryo metabolic requirement depends on the lungs, as the new breathing organ, thus limiting the O2 supply. As expected cTnT expression increased with embryonic development in correlation with the cardiovascular system development. It appears that tissue hypoxia is a necessary component of normal embryonic development.

Key Words: Gene Expression, Hypoxia, Incubation

Production, Management & the Environment - Livestock and Poultry: Broiler and Broiler Breeder Production and Management

325 Dosing with the fatty acid, sodium caprylate in the water did not reduce enteric *Campylobacter* concentrations in broilers. J. H. Metcalf*[1], K. Venkitanarayanan[2], F. S. de los Santos[1], A. M. Donoghue[3], M. L. Dirain[1], I. Reyes-Herrera[1], V. Aguiar[1], P. Blore[1], and D. J. Donoghue[1], [1]*University of Arkansas*, *Fayetteville*, [2]*University of Connecticut*, *Storrs*, [3]*PPPSRU, ARS, USDA*, *Fayetteville, AR*.

Campylobacter is a leading cause of foodborne disease and poultry is an important vector for this pathogen. Water additives are one possible method to reduce Campylobacter concentrations within preharvest poultry. Previous research in farm animals using the medium chain fatty acid, sodium caprylate, demonstrated the potential to reduce enteric pathogens. To determine the ability of sodium caprylate to

reduce Campylobacter concentrations in preharvest poultry, two separate trials were conducting dosing young chickens with this compound. Chicks were dosed for the last 72 h of a 15 d study with either 0, 0.175, 0.35, 0.7, 1.4% or 0, 0.044, 0.088, 0.175, 0.35, 0.7, 1.4% sodium caprylate in the water (Trial 1 or 2, respectively, n=10 birds/group). Chicks were challenged with Campylobacter jejuni on d 3. At d 15, chicks were sacrificed, cecal contents collected, serially diluted and plated on Campy Line Agar. Colonies were counted after 48 h of incubation at 42C. In Trial 1, only the 0.175% sodium caprylate dose caused a significant reduction in cecal Campylobacter concentrations when compared with controls. In Trial 2, there were no significant differences between any of the treatment groups. There results indicate, at least for the dosing regime used, sodium caprylate was not consistently effective in reducing enteric Campylobacter concentrations in young chickens.

Key Words: Sodium Caprylate, Campylobacter, Medium Chain Fatty Acid

326 Performance comparison between the use and non-use of an enteric health antibiotic program in commercial broiler flocks. J. Bray*[1,2], T. Cherry[1], J. Carey[2], and C. Smith[1,2], [1]*Stephen F. Austin State University*, *Nacogdoches, TX*, [2]*Texas A&M University*, *College Station*.

In the US, current trends show that enteric health antibiotics are been removed from broiler diets. The use of these antibiotics in broiler production is a contentious issue. An experiment was conducted to compare the differences in performance and yield parameters between broilers that were fed enteric health antibiotics in the diets and broilers that were not fed enteric health antibiotics in the diets. For five consecutive flocks broilers were reared under commercial settings in solid-side wall, tunnel ventilated broilers houses on built-up litter. The four-house farm was divided into two separate farms with two houses being fed the enteric antibiotic program (AGP(+)) and the other two were fed a naïve feed (AGP(-)). For each flock, 27,600 broilers were placed per house and reared for 49 days. All birds were fed commercially produced starter, grower and withdrawal rations. Individual body weights of 100 birds per house were collected at 18, 35, and 49 days of age. Feed conversion and adjusted feed conversion were calculated for each of these days. Coccidiosis lesion scores using the Johnson and Reid Method were collected at 14, 21, 28, 35, and 42 days of age. At the conclusion of each flock, a yield study was conducted on 280 birds (140 per treatment). The nature of the differences in bird performance between the treatments varied from flock to flock. Through the first two flocks, the AGP(-) birds had a high body weight with a lower feed conversion and adjusted feed conversion at 49 days of age when compared to the AGP(+) birds. Furthermore, statistically higher yield weights were detected in the AGP(-) birds through the first two flocks. By the third flock, all performance and yield parameters were equal between the two treatments. Preliminary data from the final two flocks indicates there is a slight improvement in performance and gut health among flocks receiving antibiotics.

Key Words: Broilers, Antibiotics, Performance

327 Saponin rich extracts from quillaja, yucca, soybean, and guar differ in antimicrobial and hemolytic activities. S. M. Hassan*[1], J. A. Byrd[2], A. M. Berhow[3], C. A. Bailey[1], and A. L. Cartwright[1], [1]*Texas A&M University*, *College Station*, [2]*USDA, Agricultural Research Service*, *College Station, TX*, [3]*USDA, Agricultural Research Service*, *Peoria, IL*.

Saponin rich extracts prepared from guar meal, quillaja bark, yucca, and soybean were evaluated for antibacterial and hemolytic activities. Ninety six multi-well plate assays for hemolytic and antimicrobial activities were tested using 8 serial dilutions of saponin concentrations from 5 to 666 µg/mL. A hemolytic assay used a 1% suspension of chicken red blood cells with water as a positive control and phosphate buffer solution as a negative control. A minimal inhibitory concentration (MIC) assay was used to evaluate the antibacterial activity of S. aureus, Salmonella Typhimurium and E. coli with ampicillin as a positive control and bacteria without saponin as a negative control. Optical densities of ELISA plate wells were read at 650 nm to assay hemolytic and bacterial growth. Results showed that saponin from different sources have different hemolytic and antibacterial activities. Guar and quillaja saponins were hemolytic, while yucca and soybean were not hemolytic at the concentrations tested. No saponin source had antibacterial activity against Salmonella Typhimurium or E. coli at the concentrations tested in this study. Both guar and quillaja saponin extracts exhibited antibacterial activity against S. aureus.

Key Words: Antibacterial, Guar, Saponin

328 Factors influencing distribution of pellets and fines in a commercial broiler pan feeding system. C. Hancock*, S. Beyer, C. Rude, S. Daly, K. Dobbeleare, and J. Burden, *Kansas State University*, *Manhattan*.

A series of studies were conducted to determine the impact of feed fines on the distribution of particles within a commercial broiler pan feeding system. A Chore-Time Model C2 Plus feed line with Brock feed bin and a Model 75 auger line with surge bin was constructed with 93 pans spanning the 240 foot line. For the purpose of these studies, feed was added directly to the surge bin. The motor was activated, feed was moved down the line, and the samples were collected from select pans for later analysis. For the purpose of the initial studies, we collected from pans 1, 2, 3, 14, 25, 36, 47, 58, 69, 80, 91 and 93. A grower ration formulated to meet the requirements of the NRC was manufactured at the Kansas State University Feed Mill. The feed was pelleted to a pellet durability index (PDI) of 92. The feed system was tested using 3 combinations of pellets and fines. Trmt 1 contained no added fines, trmt 2 contained 10% added fines and trmt 3 contained 20% added fines. To blend pellets and fines, a 1000 lb. Davis horizontal paddle mixer was used with a 1 minute mix time. Feed was then placed in plastic tubs until fed into the surge bin to begin the auger process. Each trmt was fully distributed throughout the line until the automated stopping mechanism was activated, at which point samples were collected by removing all feed from selected pans. The entire system was then purged of feed and the process was repeated. Pellets and fines were separated using an automated Ro-Tap system. Results indicate that the initial pans accumulated feed with 90% pellets, allowing fines to traverse into later pans where pellets only reached 70%. As the fines were collected in later pans, this then allowed

remaining pellets to traverse and flow into pans further down the line. This indicates that different pans may have different ratios of fines to pellets. The data indicates distribution of feed was similar in all 3 trmts. To maximize flock uniformity, it is important that the system releases feed in a uniform manner, however our results indicate pellets and fines may separate during the feeding process.

Key Words: Pellets, Fines, Feed Manufacturing

329 Characterization of atmospheric ammonia/ammonium forms in broiler production facilities. C. S. Smith*[2,1], J. L. Bray[2,1], T. E. Cherry[2], R. E. Lacey[1], and J. B. Carey[1], [1]*Texas A&M University*, *College Station*, [2]*Stephen F. Austin State University*, *Nacogdoches, TX*.

The nature and prevalence of the forms of ammonia nitrogen (ammonia/ammonium) within the environment of a broiler production facility is largely unknown. An annular denuder system was utilized to separate ammonia compounds in air samples into three categories. The air sample first passed through a cyclone filter which trapped large airborne particles. Subsequently, the air sample was passed through an annular denuder coated with citric acid in a glycerol solution. The denuder absorbed the gaseous form of ammonia. The final stage of the system was a boric acid trap which collected the very small particulate forms of ammonium. Samples were collected over 24 h periods from commercial broiler production facilities throughout the final 2-3 weeks of production. Volumes sampled over the 24 h period averaged 6.5 cubic meters. Following collection, fractions were extracted from the system and stored under acidic conditions until analyzed for ammonia nitrogen content by selective ion analysis. Results of the survey reveal that less than 0.1% of the ammonia nitrogen detected was attached to large particles found in the cyclone filter. The amount of gaseous ammonia trapped in the annular denuder accounted for less than 1.0% of the total with over 98% of the ammonia nitrogen recovered detected in the acid trap. These data indicate that under typical broiler production conditions, most ammonia nitrogen is in the ammonium form attached to small particles. This data will clarify the potential for environmental impact of emissions from broiler production facilities.

Key Words: Ammonia/Ammonium, Broilers, Annular Denuder

330 Effect of different feeding strategies on productivity of broiler breeders. L. F. Romero*[1], M. J. Zuidhof[2], F. E. Robinson[1], A. Naeima[1], and R. A. Renema[1], [1]*University of Alberta*, *Edmonton, AB, Canada*, [2]*Alberta Agriculture and Food*, *Edmonton, AB, Canada*.

This study was done to evaluate the effect of four feeding strategies on productivity relative to feed in settable egg production of broiler breeders ($P_{E:F}$), defined as Cumulative Settable Eggs (CSE) produced per kg of Cumulative Feed Intake (CFI). A total of 288 Ross 708 pullets were raised in floor pens, individually caged at 16 wk of age and assigned to one of four feed allocation groups. Three groups had feed allocated on a group basis with divergent target BW reached at 20 wk: Standard (STD), HIGH (STD × 1.1), and LOW (STD × 0.9). The fourth group had feed allocated on an individual bird basis (IND) and followed the STD BW target. Productivity was assessed at the end of the experimental period (56 wk) and a production function of the form $CSE=a+b(CFI^c)$ was fit in every group to compare the dynamics of $P_{E:F}$ relative to the use of feed. The F statistic was used to evaluate the fit of separate groups versus a pooled fit. Final CSE production (to 56 wk of age) of LOW hens was lower (131.67 eggs, $P<0.01$) than IND, STD and HIGH (148.71, 144.67 and 145.65 eggs), which did not differ significantly. However, HIGH birds showed lower $P_{E:F}$ (4.17 eggs / kg, $P<0.05$) than IND, STD and LOW (4.61, 4.43 and 4.28 eggs / kg), and LOW hens showed lower $P_{E:F}$ than IND ($P=0.03$). Fitting the production function in every group separately showed better fit than when pooled ($P<0.0001$). IND hens had the lowest variability of the residuals (MSE=81.76). As every bird was fed based on individual requirements, the function of this group is a reflection of the individual potential of $P_{E:F}$. This is consistent with a higher c coefficient (=1.057) of IND, which indicates a greater productivity at higher levels of CFI. In contrast, HIGH showed $c=1.021$, a more linear trend than IND hens, but had lower $P_{E:F}$ than LOW, STD and IND along the experimental period, demonstrating that this strategy was inefficient compared with the others. The c coefficients of STD and LOW were 0.941 and 0.884, showing decreasing productivity as the CFI increased.

Key Words: Broiler Breeders, Productivity, Feeding Level

331 Effect of reducing body weight variability on the sexual maturation of broiler breeder females. R. A. Renema*[1], L. F. Romero[1], A. Naeima[1], M. J. Zuidhof[2], and F. E. Robinson[1], [1]*University of Alberta*, *Edmonton, AB., Canada*, [2]*Alberta Agriculture and Food*, *Edmonton, AB., Canada*.

Sexual maturation traits of pullets fed either on a group basis or an individual basis were assessed in Ross 708 broiler breeders. Pullets (208) were assigned to a feeding treatment at hatch and reared together in floor pens prior to placement in individual cages at 16 wk of age. In order to study the impact of initial BW, pullets were grouped in one of three BW groups (Low, Std, or High) using the mean plus or minus 0.5 SD as the threshold. Half of the birds received a common feed allocation based on group BW (Control: CON), while remaining birds received a custom feed allocation to align their individual BW profile with management guide targets (Individual; IND). The IND BW profiles were fully converged by 20 wk of age. Photostimulation was at 23 wk of age. Carcass morphology was monitored between 16 wk and sexual maturity (SM). After their first egg, 64 birds (32/tmt) were dissected for determination of fleshing, fatness, and reproductive morphology. Remaining birds were kept for an egg production study. The CV of BW at 16 wk was 12.8%. By 23 wk it was 6.2% in CON birds and 1.4% in IND birds. ($P<0.0001$). Mean age at SM differed by only 0.15 d between feeding treatments (NS). However, age at first egg was affected by initial BW group ($P=0.018$). Low-IND birds entered lay 5 d faster than Low-CON birds and had an 11% longer total gut length. The range in mean SM age was 0.8 d among IND BW groups compared to 6 d among CON groups. Frame size (as shown by shank and keel length) was only affected by initial BW group, with smaller birds growing more between 16 wk and SM. Feeding treatment did not affect fleshing or fatness at SM. Mean oviduct weight and ovarian morphology parameters were also similar. Variability in LYF number was lower in IND (16.9%) compared to CON birds (22.3%), but was slightly higher for total LYF weight (CV=23.2% vs. 20.8%). Changes in the Low BW group accounted for much of the improved uniformity due to the IND feeding treatment.

Key Words: Broiler Breeder, Sexual Maturity, Ovarian Morphology

332 The energetics of female broiler breeders are affected by genotype and environment. M. J. Zuidhof*[1], R. A. Renema[2], F. E. Robinson[2], and L. F. Romero[2], [1]*Alberta Agriculture and Food*, *Edmonton, AB, Canada*, [2]*University of Alberta*, *Edmonton, AB, Canada*.

This analysis was conducted to investigate the partitioning of ME by broiler breeder (BB) hens. A 3 × 4 × 2 factorial design trial with 3 BB strains, 4 rearing BW profiles and 2 photostimulation (PS) ages determined the impact of strain and management on female BB energetics during lay. Ross 708, Ross 508, and Hubbard Hi-Y BB were reared on BW profiles that diverged at 3 wk and converged at 32 wk of age as follows: STANDARD (mean target BW profile of 3 strains used); LOW (12 wk BW target=25% lower than STANDARD followed by rapid gain to 32 wk); MODERATE (12 wk BW target=150% of STANDARD followed by lower rate of gain to 32 wk); and HIGH (12 wk BW target=200% of STANDARD followed by minimal growth to 32 wk). Birds were photostimulated at 18 or 22 wk. A total of 288 hens were evaluated. A standard metabolic BW coefficient of 0.67 was used to estimate maintenance requirements. Residual ME Intake (RI) was calculated as the difference between the theoretical ME requirements of a bird and actual ME intake. Smaller values indicate greater efficiency. The average ME requirement for maintenance was 139 kcal/kg$^{0.67}$; for BW gain was 1.53 kcal/g; and for egg production was 1.80 kcal/g. Efficiency during lay differed due to rearing BW profile, strain, and age at PS. Rearing BW profile had the most dramatic effect on BB energetics. RI increased in all treatments until 30 wk, and then decreased, except in the HIGH treatment. Birds reared on the HIGH BW profile were most efficient, followed by MODERATE, then STANDARD, then LOW birds (RI= -22, -5, 9, and 20 kcal/d, respectively; P<0.0001). Early and overall RI was reduced in 18- vs 22-wk PS birds (RI=9 vs -8 kcal/d, respectively; P>0.0001). Overall RI of Ross 708 hens was -5 kcal/d. This was more efficient than 3 kcal/d, the average RI of Hubbard Hi-Y and Ross 508 strains (P<0.0001).

Key Words: Residual ME Intake, Nutrient Partitioning, Broiler Breeder Management

333 Spread of a marker *Salmonella* in the presence of background *Salmonella* as detected from broiler litter. R. J. Buhr*[1], L. J. Richardson[1], N. A. Cox[1], and B. D. Fairchild[2], [1]*USDA, ARS*, *Athens, GA*, [2]*University of Georgia*, *Athens*.

The impact of preexisting *Salmonella* in day old chicks on the colonization ability of subsequent marker *Salmonella* strains is not known as both may compete for the same intestinal niches. Chick-box pads were sampled to detect the presence of background *Salmonella* at placement and the flock was determined to be positive (serogroup C3). Day old chicks were placed 40/pen into 6 adjacent pens. In the two end pens (pens 1 and 6) one chick was orally inoculated with 0.1 mL of a 10^3 cfu/mL suspension of a naladixic acid resistant *Salmonella* cocktail (*S. heidelberg*, *S. montevideo*, and *S. typhimurium*). At 1 through 7 wk, the pens were sampled using both conventional drag swabs (CDS) and intermittently stepped on drag swabs (ISODS), two of each per wk. At 1 and 2 wk both the challenge and adjacent pens were positive for the marker *Salmonella* from all drag swab samples (16/16). At 2 wk the middle pens were still negative for the marker strain and 1 positive sample for the background *Salmonella* was detected with an ISODS. At 3 wk the number of marker *Salmonella*-positive samples peaked and extended into the middle pens with 4/4 ISODS and 2/4 CDS positive samples (overall 22/24). Then at 4 and 5 wk, the number of marker *Salmonella*-positive samples gradually decreased, mainly from the middle pens from 17/24 to 16/24 total samples positive. The marker *Salmonella* continued to decline at 6 and 7 wk from 12/24 and 3/24. Overall, ISODS samples had significantly more positive samples (57/84) than CDS (45/84) and all but 10/84 positive samples coming from the challenged or adjacent pens. By challenging only one chick per pen, the marker *Salmonella* spread easily from the challenged to adjacent pens and into the center pens. The *Salmonella* prevalence in the litter was the highest at 3 wk and then decreased by 7 wk. The presence of a background *Salmonella* at placement does not appear to inhibit colonization by the marker *Salmonella* or the spread into adjacent pens. However, at 6 wk *Salmonella* recovery from litter had progressively declined from the challenge pens (7/8), to the adjacent pens (4/8), to the middle pens (1/8).

Key Words: *Salmonella* Detection, Litter Sampling, Drag Swab

334 Effect of starter period duration on live oocyst vaccination efficacy and broiler performance following subsequent *Eimeria* challenge. J. T. Lee*[1], N. H. Eckert[1], S. M. Stevens[1], S. Anderson[1], P. Anderson[1], H. D. Danforth[2], A. P. McElroy[3], and D. J. Caldwell[1], [1]*Texas A&M University*, *College Station*, [2]*USDA-ARS*, *Beltsville, MD*, [3]*Virginia Polytechnic Institute and State University*, *Blacksburg*.

An experiment was conducted to investigate the effect of dietary starter period duration on broiler performance during a live oocyst vaccination program followed by field-strain Eimeria challenge. The experimental design was a 3 x 2 x 2 factorial with the variables of starter diet duration (13, 17, and 21 d), vaccination, and a mixed species *Eimeria* challenge. On d 21, broilers were challenged with a mixed species *Eimeria* inoculum containing *E. acervulina*, *E. maxima*, and *E. tenlla*. On d 27, 10 broilers from each replicate pen were necropsied for the determination of intestinal lesion development. Average body weights for vaccinated and non-vaccinated broilers were similar (P>0.05) at 13 d of age. On day 17 and 21, vaccinated broilers had lower (P<0.05) average body weights compared to non-vaccinated broilers while no effect was observed with respect to starter duration. Feed conversion ratios were similar (P>0.05) for vaccinated and non-vaccinated broilers pre-challenge. Broilers switched to the grower diet on d 13 had an increased (P<0.05) feed conversion compared to broilers switched to the grower diet on d 17 and d 21. During the challenge period, body weight gains and feed conversion ratios were similar for all non-challenged treatments. In challenged broilers, all vaccinated treatment groups gained more (P<0.05) body weight and displayed reduced (P<0.05) feed conversions ratios than non-vaccinated broilers post-challenge. Cumulative feed conversion ratios (1d to 27d) were similar for all non-challenged treatments. Lesion development was reduced (P<0.05) in the upper and lower intestinal segments in vaccinated challenged broilers compared to non-vaccinated challenged broilers. Live oocyst vaccination resulted in improved broiler performance and reduced lesion development during a field strain *Eimeria* challenge regardless of starter period duration.

Key Words: *Eimeria*, Broiler, Vaccination

335 *Campylobacter* contamination of broilers fed cottonseed or cottonseed products. J. A. Byrd*[1], R. D. Stipanovic[2], J. L. McReynolds[1], L. F. Kubena[1], and D. J. Nisbet[1], [1]*USDA/ARS/SPARC, Food and Feed Safety Research Unit*, *College Station, TX*, [2]*USDA/ARS/SPARC, Cotton Pathology Research Unit*, *College Station, TX*.

Previous research has demonstrated that broiler breeders fed cottonseed meal had significant reductions in *Campylobacter* when compared to soybean controls. In the present experiment, three studies were conducted to evaluate the effect of dietary cottonseed meal or gossypol on the incidence of *Campylobacter* and *Salmonella* colonization in broilers. In the first study, an *in vitro* fermentation using cecal contents from six-week-old broilers were combined with gossypol (4 µg/mL) and challenged with either *Campylobacter jejuni* (10^4 cfu/mL) or *Salmonella* Typhimurium (ST; 10^4 cfu/mL) and evaluated for the presence of these bacteria at 1, 3, 5, or 18 hours after challenge. *Campylobacter* was significantly reduced from the gossypol treated contents one h after exposure as compared to the controls. *Salmonella* was not significantly reduced compared to the control. In the second study, day-of-hatch broiler chicks were fed a diet containing 0, 300, or 600 mg/kg of gossypol for 10 days and challenged with ST at d 3. The incidences in cecal *Salmonella* concentrations were not significantly different in broilers fed gossypol when compared to the controls. In a third study, market-age-broilers were fed a diet containing either a corn-soybean control, 20% cottonseed meal, 5% cottonseed hulls, or 5% whole cottonseeds for 12 weeks to evaluate the effects on *Campylobacter* cecal colonization. Broilers fed each diet became *Campylobacter* positive after one week and remained positive until termination of the experiment. The results of the present study suggest that broilers fed cottonseed or cottonseed products were not protected from *Campylobacter* or *Salmonella* colonization.

Key Words: Broiler, *Campylobacter*, Cottonseed

Production, Management & the Environment - Livestock and Poultry: Dairy Production and Management II

336 Reasons for culling in Iranian Holstein cows. A. A. Naserian[1], M. Sargolzaee[1], M. Sekhavati[1], and B. Saremi*[2], [1]*Ferdowsi University Of Mashad, Agric college, Animal Science Department*, *Mashhad, Khorasan Razavi, Iran*, [2]*Education Center of Jihad-e Agriculture, Animal Science Departemnt*, *Mashhad, Khorasan Razavi, Iran*.

Culling of dairy cows is probably one of the most complex decisions in dairy operations. It involves several factors and farmers consider e.g. stage of lactation, age, health status, level of milk production and current reproductive status of cows while making decisions about which cows to keep and which ones to call. The aim of this study was to determine the profiles of culled cows in order to access the possible contribution to economic losses due to health disorders in the dairy herds of Khorasan province (Northeast of Iran). Data regarding all exits of cows from the herd were collected during a 5-year prospective survey in 15 large dairy commercial Holstein herds with over 4000 milking cows totally (From March 1999 to March 2004). All herds were recorded by an official milk-recording scheme. The management and feeding systems were almost similar in all herds. Rolling herdâ€™s averages were also similar in all herds; over 24000 lb. A polytomous stepwise logistic regression method was used because it allows the use of a non-ordinal categorical variable. The model was run (Procedure PR of BMDP). Table 1 shows the results of this study. The most frequent primary culling reasons were infertility and health disorders, 25.13, 28.57 of total cull respectively. Percentages of six groups of culling reasons for level of parity showed that the first parity level had more frequent reproductive problems and health problems too. Therefore, in this study, more than one half of the cows were declared culled for health or reproductive related problems.

Table 1. Primary culling reasons across parities (Iranian Holstein cows 1999-2004)

	Parity						Total
Problem	1	2	3	4	5	>5	%
Reproductive	6.02	4.62	3.54	3.76	3.97	3.22	25.13
Mastitis	4.08	1.84	0.97	1.18	1.50	1.50	11.06
Lameness	2.15	1.50	2.47	2.50	1.18	2.26	11.07
Milk fever	0.54	0.75	1.18	0.86	1.07	1.61	6.02
Low Milk yield	2.26	2.79	3.44	1.61	2.15	5.91	18.15
Health disorders	5.70	3.22	4.83	5.59	4.19	5.05	28.57

Key Words: Culling, Parity, Health and Production

337 Commercial application of sex-sorted semen in Holstein heifers. J. M. DeJarnette*[1], R. L. Nebel[1], B. Meek[2], J. Wells[3], and C. E. Marshall[1], [1]*Select Sires, Inc.*, *Plain City, OH*, [2]*Cache Valley Select Sires*, *Logan, UT*, [3]*All West Select Sires*, *Turlock, CA*.

Flow cytometric procedures were used to produce sex-sorted (SS; ~90% X-bearing), cryopreserved Holstein semen for commercial use at 2.1 x 10^6 sperm/dose. Data were obtained from 108 herds of Holstein heifers via electronic back-up of herd records and personal communications. Conception rates (CR) achieved at first services with conventional semen (CS) were used to assess relative field performance and were assumed to be 60% when CS data were not available. The unadjusted CR to SS across 121 herds was 44% (n=16,587). The CR achieved by SS averaged 85±2.9% of that achieved with CS at first service and 74% of herds achieved CR ≥70% of that obtained with CS at first service. Among 25 herds that used ≥100 doses of SS (n=608±122 per herd), CR to SS averaged 48±1.9% (range 33 to 72%) compared to a CS first service CR of 54±1.8% (range 38 to 70%; n=525±109 per herd). Among heifers bred to SS, the average age at AI (425±0.81 d, n=3969) and at calving (708±1.31 d, n=2280) was shorter ($P<0.01$) than for heifers bred to CS (461±1.05 d, n=2367; 745±1.19 d, n=4028, respectively) reflecting recommendations for preferential use of SS at first service. Among heifers that failed to conceive at AI, the percentage re-bred in a normal 18 to 24 d interval was greater ($P<0.05$) for SS (70%, n=5,495) than CS (64%, n=3,712), which may be a function of more accurate estrus detection among SS bred heifers or a result of increase rates of fertilization failure to SS. The percentage of abortions did not differ ($P>0.05$) among heifers that conceived to SS or CS (1.4%, n=1810 vs. 1.9%, n=4902, respectively). Among single births, the percentage of female calves was greater ($P<0.001$) for SS (90%, n=3,361) than CS (48%, n=10,999). Among twin births, a greater percentage ($P<0.01$) of female-female pairs were observed for SS (75%, n=20) than CS (22%, n=121). Legitimate comparisons of CR for SS and CS in the commercial setting are difficult due to bias in semen use, however these data imply >70% of herds achieved CR with SS that were ≥70% of first service CR obtained using CS with a resulting female gender bias of ~90%.

Key Words: Sexed Semen, Flow Cytometry, Heifer AI

338 Effect of out-wintering pad design on cow hoof health. K. O'Driscoll*[1,2], L. Boyle[1], P. French[1], and A. Hanlon[2], [1]*Moorepark Dairy Production Research Centre*, *Fermoy, Co. Cork, Ireland*, [2]*University College Dublin*, *Dublin, Ireland*.

This study aimed to evaluate four over-wintering options for spring calving dairy cows; uncovered [UP] and sheltered [SP] woodchip pads, both with a concrete feed face, a woodchip pad with a self-feed silage pit on top [SF] and indoor cubicles [IC], with regard to hoof health. Cows (n=96) were assigned to treatment using a randomized complete block design from 17 Nov (pluriparous) or 5 Dec (primiparous) until calving (mean=21 Feb 06) then turned out to pasture. Sole lesions (SL) heel erosion (HE) and dermatitis (D) on hind feet were scored according to severity at housing, calving, 8 & 14 weeks post partum (pp). Hardness (Shore D scale) of all claws was recorded at each inspection using an analogue duromoter. Data was analyzed using SAS. A mixed model was used to analyze SL and HE. Kruskall-Wallis and Wilcoxon tests were used to analyze D. Correlations between hardness and pathologies were investigated. Treatment had no effect on SL score, but scores increased over time ($P<0.001$), with an interaction between treatment and time ($P=0.1$). There were higher HE scores on SF than IC and SP ($P<0.01$). Cows on SF had highest D scores and IC lowest ($P<0.05$). Higher D scores occurred in SF than IC ($P<0.01$) and SP ($P<0.05$) at calving, and SF tended to have higher scores than IC 8 weeks post calving ($P=0.06$). Lateral claws were harder than medial claws ($P<0.001$). Hardness was highest at housing, lower at calving and 8 weeks pp ($P<0.05$), but no different 14 weeks pp. The hooves of IC and SP cows were harder than those of SF and UP cows ($P<0.05$). There was no correlation between hardness and D, and only weak correlations with SL ($P<0.001$; $r=-22.602$) and HE ($P<0.05$; $r=-0.061$). Exposure to excreta and moist conditions are risk factors for D and HE, explaining higher levels of these pathologies in SF than the other treatments as the feedface had no manure removal system. In IC the passageways as well as feedface were cleaned of manure explaining lower D scores. Provision of shelter on SP reduced exposure to environmental moisture which ensured hooves remained as hard as those in IC. However, low correlations between hardness and pathologies indicate that other factors are involved in pathology development.

Key Words: Dairy, Housing, Hoof Health

339 Correlation between tarsal lesions on dairy cows housed in free-stalls and culling rate, somatic cell count, percent mature cows, and milk production by stall base. W. K. Fulwider*, T. Grandin, D. J. Garrick, T. E. Engle, W. D. Lamm, N. L. Dalsted, and B. E. Rollin, *Colorado State University*, *Fort Collins*.

The objective of this study was to determine relationships between tarsal lesions, management, and outcomes by base: rubber-filled mattress (RFM), sand, and waterbeds (WB) from data collected on 85 dairies. Somatic cell count (SCC) was correlated with stall width (-0.26, $P = 0.02$). Percent of cows with tarsal swelling was correlated with stall length (-0.23, $P = 0.05$). Somatic cell count was correlated with stall width (-0.50, $P = 0.01$) and length (-0.46, $P = 0.01$) on RFM. Severe swellings were correlated with stall width (-0.52, $P = 0.01$) and SCC (0.60, $P = 0.001$) on RFM. Inadequate stall dimensions may increase lesions and SCC. Percent mature cows (fourth lactation or greater) was 13% (RFM), 14% (sand), and 20% (WB). Percent mature cows on sand was related to stall length (0.56, $P = 0.01$). Base types may require different stall dimensions to maximize cow well-being and productivity. Cull rates were 29% (RFM), 26% (sand), and 23% (WB). Within base type dairies were split into thirds according to the percentage of cows with tarsal swellings. Percent of cows with swellings differed for RFM ($P < 0.0001$): 4% in the best herds and 27% in the worst; corresponding best and worst for sand were 0% and 5% ($P < 0.01$); while (WB) were 1% and 9% ($P < 0.0001$). Sand and waterbeds may require less management than RFM. Rolling herd average (RHA) by bases were 8,399 L (RFM), 8,626 L (sand), and 8,172 L (WB). When base type dairies were split into thirds according to tarsal swelling, only RFM was different for RHA ($P = 0.01$). The worst dairies produced 1,816 L additional milk, with the highest culling rate (31%). Sand dairies differed in production by 227 L, the high third for lesions had the high RHA. There was no difference in RHA for (WB). Annual death rate (0.34, $P < 0.002$) and percent lame on visit day (0.45, $P < 0.0001$) were correlated with SCC; these rates were highest on RFM dairies (0.52, $P = 0.004$) and (0.52, $P = 0.003$). Inadequate stall dimensions may contribute to lameness, lesions, premature culling and increased death rate. Lameness and lesions may increase SCC.

Key Words: Somatic Cell, Lesion, Cull

340 Effect of body condition score at calving on production and reproduction performance in dairy herds of Argentina. J. Grigera*[1], F. Busso[2], F. Bargo[1], and C. Corbellini[2], [1]*Elanco Animal Health, ACBSCR*, [2]*INTA Pergamino*.

Claves is a program conducted by INTA and Elanco to monitor body condition score (BCS) and metabolic diseases of transition dairy cows in Argentina. A 4000-cows data set from 15 dairies was used to determine the relationship between BCS at calving and production and reproduction performance. Body condition score (1 to 5 scale) was measured at calving, milk production at 15, 45, and 75 DIM, and subclinical ketosis (milk BHBA concentration, Ketotest) at 30 DIM. A complete randomized blocked design was used to analyze the data using the SAS PROC MIXED model with dairy as random variable and parity and calving season as fixed variables. A significant ($P <0.05$) interaction between BCS at calving and parity was found for milk production. Primiparous cows produced more ($P < 0.05$) milk when calving at 3.75. Milk production of primiparous cows decreased ($P < 0.05$) linearly as cows calved with BCS lower than 3.75. Multiparous cows produced more ($P < 0.05$) milk when calving at 3.25. Milk production of multiparous cows was lower ($P < 0.05$) when calved with BCS lower or higher than 3.25. Cows losing 0.75 of BCS during the first 30 DIM produced more ($P < 0.05$) milk than cows losing 0.25 (28.4 vs. 27.6 kg/d). Losing more than 0.75 points of BCS did not increase ($P > 0.05$) milk production. Days to first service and days to conception were lowest ($P < 0.05$) for cows calving at 3.25 or 3.75. Subclinical ketosis positive cows (≥ 100 µm/L milk BHBA) had higher ($P < 0.05$) BCS at calving (3.52 vs. 3.40) and lower ($P < 0.10$) milk production at 15 DIM (25.5 vs. 26.7 kg/d) than negative cows. Positive cows were 0, 1.9, 1.5, 3.3, and 3.5% for cows calving at 2, 2.25, 2.75, 3.25, and 3.75, respectively. The low incidence of ketosis is probably associated to the use of monensin in the transition diets. Body condition score at calving affected production and reproductive performance of dairy herds in Argentina. Optimum BCS at calving for production and reproduction performance were 3.75 and 3.25 for primiparous and multiparous cows, respectively.

Key Words: BCS, Performance, Ketosis

341 Ration sorting in freestall dairy herds. M. I. Endres* and L. A. Espejo, *University of Minnesota*, *St. Paul*.

The objectives of this study were to evaluate ration sorting and investigate herd-level risk factors for sorting by high producing dairy cows housed in freestall barns. Fifty randomly selected dairy herds participated in the study which was conducted during the summer. Five representative samples of TMR were collected from the high group feed bunk during the one time visit to represent the initial ration as delivered to the cows, three other samples collected every 2-3 hours, and the accumulated orts cleaned out of the bunk by the feed manager. At every sampling time, measurement of the particle size of the TMR was performed in triplicate by the same person using the 3-screen and bottom pan The Pennsylvania State University Particle Separator, and a sample was taken for DM, NDF, and CP analysis. The average of mass retained at each sampling time was used to calculate the geometric mean of particle length. No herds were below the minimum recommendation of 2% particles retained on the upper screen; however, 52% of them were above the maximum recommended limit of 8%. The geometric mean particle length of the TMR delivered to the 50 high production groups was 6.4 mm ± 1.4 mm. The TMR had physical and chemical changes across the samples. After feed delivery cows sorted the TMR against long particles favoring the consumption of shorter particles. The overall geometric mean of particle size increased from 6.4 mm in the initial ration to 9.2 mm in the orts. The NDF content increased 6.75 percentage units whereas the CP content decreased 1.52 percentage units in the orts compared to the initial sample. The multivariate regression model used for the analysis of factors associated to changes in the geometric mean of the particle size of the ration indicated that frequency of feed delivery, initial geometric mean of the particle size of the ration, hay content of the ration, and time after feed delivery were associated with ration sorting. Additionally, linear feed bunk space per cow tended to be associated with ration sorting. In contrast, type of feed bunk barrier, frequency of feed push-up, percent of forage in the ration, and DM content of the initial ration were not associated with ration sorting.

Key Words: Ration Sorting, Rsk Factors

342 The effect of breed and feeding a split ration to lactating hair sheep on ewe body temperature in the tropics. R. W. Godfrey*, M. C. Vinson, and R. C. Ketring, *University of the Virgin Islands, Agricultural Experiment Station*, *St. Croix, US Virgin Islands*.

Lactating St. Croix White and Dorper × St. Croix White ewes grazing guinea grass pastures were used to evaluate the effect of breed and feeding a split ration on body temperature during the cool (March through April) and warm (July through August) seasons. In each season ewes were assigned to treatments (n = 8/treatment) based on breed, age and number of lambs. Treatments consisted of individually feeding 0.9 kg concentrate (16.4% CP, 68% TDN) in the morning (AM) or afternoon (PM), 0.45 kg in the morning and afternoon (AM-PM) or no feed (Control) for 46 d beginning on d 6 (lambing = d 0). Ewes were fitted with intravaginal temperature data loggers, set to record vaginal temperature (VT) at 5-min intervals, for 48 h in wk 2, 5 and 8 postpartum. The mean temperature, relative humidity and and temperature humidity index during the cool and warm seasons were 25.8 °C, 85.9% and 76.1 and 28.3 °C, 86.7% and 80.6, respectively. There was no effect of season ($P > 0.10$) so all data were pooled across season. During wk 2 there was no difference ($P > 0.10$) in VT around the AM or PM feeding times among treatment groups. During week 5 the AM-PM fed ewes had higher ($P < 0.01$) VT than ewes in other groups around the times of feeding. During wk 8 the AM-PM and the PM fed ewes had higher VT ($P < 0.01$) than either the AM fed or Control ewes. Data from all ewes fed in the PM (PM and AM-PM; PMALL) was pooled and compared to the Control and AM ewes. During wk 2 there was no difference ($P > 0.10$) in VT around the AM or PM feeding times among the groups. During wk 5 and 8 the PMALL ewes had higher ($P < 0.01$) VT than Control or AM ewes around the times of feeding. To determine breed differences, data were pooled across treatments and compared between breeds. Dorper × St. Croix White ewes had higher ($P < 0.05$) VT than St. Croix White ewes during wk 5 and 8 but not during wk 2 ($P > 0.10$). The results show that body temperature of ewes can be influenced by time of feeding and breed. Ewes fed in the afternoon had elevated body temperatures which could make them more susceptible to heat stress.

Key Words: Sheep, Feeding, Body Temperature

343 Effects of heat stress on production, lipid metabolism and somatotropin variables in lactating cows. M. L. Rhoads*[1], R. P. Rhoads[1], S. R. Sanders[1], S. H. Carroll[1], W. J. Weber[2], B. A. Crooker[2], R. J. Collier[1], M. J. VanBaale[1], and L. H. Baumgard[1], [1]*University of Arizona*, [2]*University of Minnesota*, *St. Paul*.

To delineate differences between heat stress and decreased feed intake on physiological and metabolic indices, we conducted a heat stress experiment where a thermal-neutral control group (n=6) was pair-fed/underfed (UF) to match nutrient intake with heat-stressed (HS) Holstein cows (n=6). Multiparous cows (140 DIM, 663 kg BW) were subjected to two experimental periods: 1) thermal neutral (TN) and ad libitum intake for 9 d and 2) HS or UF for 9 d. HS conditions were cyclic with temperatures ranging from 29.7 to 39.2°C. During each period all cows received an I.V. challenge of epinephrine (EPI, 1.4 µg/kg BW, d 6), growth hormone releasing factor (GRF 4 µg/100 kg BW, d 7), and a somatotropin (ST, 15 µg/kg BW, d 9) and had ST profile characteristics assessed (sampled every 15 min for 6 hr, d 8). Results were analyzed as repeated measures using PROC MIXED of SAS. Rectal temperatures and respiration rates increased during HS (38.7 to 40.2°C and 46 to 82 breaths/min). HS reduced DMI by 32% and by design, UF cows had similar intake reductions (34%). Milk yield was decreased by HS (45%, 14.5 kg/d) and UF (19%, 6.7 kg/d), but there were little effects on milk composition. Reduced DMI only accounted for 46% of the decreased milk production by HS. Both HS and UF markedly reduced EBAL, but only UF increased basal NEFA levels (136 vs. 298 µEq/l). Neither NEFA response to EPI nor ST response to GRF differed between treatments. Area under the curve and rate of ST disappearance in response to the ST challenge did not differ between treatments. During the 6 h bleed, there were little or no treatment differences on ST pulsatility and mean ST (4.25 ng/ml). Reduced nutrient intake accounted for about 50% of the HS-induced decrease in milk yield and this appears to have occurred independent of changes in the ST system. Differences in basal NEFA between UF and HS suggest a shift in metabolism and nutrient partitioning which may help explain reduced milk yield during heat stress.

Key Words: Heat Stress, Somatotropin, Lipid Metabolism

344 Effect of encapsulated niacin on resistance to acute thermal stress in lactating Holstein cows. R. B. Zimbelman*, J Muumba, L. H. Hernandez, J. B. Wheelock, G. Shwartz, M. D. O'Brien, L. H. Baumgard, and R. J. Collier, *University of Arizona*.

Twelve multiparous Holstein cows producing an average of 31.7 kg/d and balanced for parity and stage of lactation were randomly assigned to either 0 g encapsulated niacin/d (C) or 12 g niacin/d (NIASHURETM®) (Trt) and were exposed to two environmental temperature patterns, thermoneutral (TN) and heat stress (HS). The temperature humidity index (THI) range of TN pattern never exceeded 72 while HS consisted of circadian THI temperature range exceeding 72 for 12 hours per day. Milk yields were recorded twice a day and milk sampled once a day for composition. Cows were fed twice a day and refusal and water intake was measured once a day. Respiration rates, surface temperatures of both shaved (S) and unshaved (U) areas were taken at the rump, (ST-R-S, ST-R-U) shoulder, (ST-S-S, ST-S-U), and tailhead (ST-T-S, ST-T-U), and sweating rates (SR) of the shoulder shaved (SR-S) and unshaved (SR-U) areas 4× daily. Rectal temperatures (RT) were measured four times a day. Cows in Trt had increased DMI (40.7 vs 37.7,g/d) compared to cows in C. Surface temperatures were unaffected by Trt but were affected by shaving (32.5 shaved vs. 31.4°C unshaved). Cows given Trt had a tendency for higher average sweating rates when shaved (66.3 vs 57.8 g/M2/hr, P=0.11) and numerically for unshaved (57.4 vs 52.7 g/M2/hr) over the entire 24 hour period and these differences grew larger during periods of peak thermal stress along with the entire study (62.0° shaved vs. 55.0° unshaved). Between 11:00AM and 4:00 PM average sweating rate for Trt group was higher than C (81.1 vs. 68.2 g/M2/hr shaved; P<0.0001 and 70.6 vs. 62.3 unshaved; P<0.0001). Vaginal temperatures recorded at 15 min intervals and averaged over last 72 hours of period 2 (HS) were lower (38.4 vs. 38.0°C; P <.0001) for cows given Trt compared to cows in C. We conclude that cows given encapsulated Niacin had higher sweating rates and lower core temperatures during acute thermal stress.

Key Words: Niacin, Heat Stress, Sweating Rate

345 Effect of level of production and intensive cooling in summer on productive and reproductive performance of high yielding dairy cows. I. Flamenbaum*[1] and E. Ezra[2], [1]*Ministry of Agriculture, Extension Service*, *Beit-Dagan, Israel*, [2]*Israel Cattle Breeders Association*, *Caesarea, Israel*.

The effects of production level and heat stress relief were studied during 2005 in a large scale survey including 22 dairy herds, averaging 300 cows each and a total of 6600 cows. All the dairy herds were located in the coastal part of Israel. Cows in all the herds were held under similar housing system, milked 3 times per day and fed for ad libitum intake a TMR, distributed twice daily. Twelve of the herds were of high and 10 of low production level (previous year winter Economical Corrected Milk - ECM yields averaged 41 and 35 kg/d, respectively). Cows in half of the herds in each production level were intensively cooled (IC) during summer, using a combination of wetting and forced ventilation for 10 cooling periods and a total of 7 cumulative hours/d. Cows in the second half of the herds in each production level were moderately cooled (MC) by a combination of wetting and forced ventilation in the holding pen, only before milking. Winter (Jan-Mar), spring (Apr-Jun), summer (Jul-Sep) and autumn (Oct-Dec) ECM production averaged 41.5, 41.0, 40.7, 41.7 kg/d, respectively, for the IC herds, and 38.5, 37.7, 33.8, 35.7 kg/d, respectively, for the MC herds of the high production level. During the same seasons, in the low producing herds, ECM production averaged 36,5, 38.0, 36.8, 37.8 kg/d, respectively, for the IC herds, and 34.4, 34.6, 30.2, 33.5 kg/d, respectively for MC herds. Intensive cooling, significantly reduced summer decline in ECM production and conception rate for herds of both production levels (P<0.01). Conception rate of first and second insemination, performed in winter, spring, summer and autumn averaged 39, 31, 19, 29%, respectively, for the IC, and 39, 30, 12, 29%, respectively, for the MC high producing herds. For the same seasons, in the low producing herds, conception rates averaged 40, 38, 25, 40%, respectively in the IC and 39, 25, 3, 29%, respectively, in the MC herds. Intensive cooling almost eliminated summer decline in milk production, regardless of the level of production and reduced about half of the summer decline in conception rate. Intensive cooling had greater impact on improving conception rate in low, than in high producing herds.

Key Words: Intensive Cooling, Milk Production, Conception Rate

346 Reducing freestall availability without limiting feed access during dry period does not affect subsequent milk yield. J. M. Velasco*, K. K. Fried, T. F. Gressley, E. D. Reid, T. C. Hausman, and G. E. Dahl, *University of Illinois*, *Urbana*.

Comfortable housing during the dry period may impact the dairy cow as reflected in her health, reproductive and productive performance during lactation. Stocking density is a critical component of overall cow comfort, yet the impact of stocking density during the dry period is unknown. Further, the relative contribution of limiting feed access versus stall access to stocking density effects is unknown. To determine if reduced freestall availability during the dry period had an impact on subsequent milk yield and performance, we used 40 Holstein cows dried off approximately 58 ± 12 d before calving and assigned to 70% stall availability (70SA; n=20) or 100% stall availability (100SA; n=20) for the entire dry period. All cows were fed individually using a Calan gate system and dry matter intake (DMI) was recorded during the dry period. Prolactin (PRL) concentration was measured in samples collected every other week from dry off until calving as an indicator of relative stress. Body condition score (BCS) was measured every other week. Treatments ended at calving when all cows were managed in a commercial facility throughout lactation. Cows were milked 3 times per day; milk production was recorded until 150 d in milk. Days dry averaged 57.3 for 70SA and 59 for 100SA (P>0.4). There was no difference between treatments in DMI, PRL, BCS and milk production (P>0.5). When dry, cows on 70SA consumed 15.3kg/d DM compared with 14.9 kg/d for cows on 100SA. BCS was not different between treatments, and scores averaged 3.2 for 70SA versus 3.1 for 100SA cows. One day after treatment began and at calving, PRL concentrations averaged 14.8 and 25.8 ng/mL for 100SA and 16 and 24.4 ng/mL for 70SA, respectively. Milk production was 43.9 kg/d for 100SA and 43.5kg/d for 70SA. These results suggest that dry cows can adapt to substantial reductions in stall availability during the dry period if adequate access to feed is maintained, and not experience a reduction in subsequent milk yield.

Key Words: Freestall Availability, Dry Period, Milk Yield

347 Using ear canal temperature to predict vaginal temperature. B. H. Carter*, T. H. Friend, M. A. Tomaszewski, J. R. Fisher, and G. M. Bingham, *Texas A&M University*, *College Station*.

The objective of this study was to evaluate the efficacy of using ear canal placement of a temperature data logger as a predictor of vaginal temperature. Temperature data loggers are commonly used to sample body temperature in unrestrained animals. Temperature loggers have previously been placed in the vagina and(or) ear canal of cattle, horses and sheep. Two trials were conducted in Texas during summer (n = 7) and winter (n = 9) conditions when ambient temperature ranged from -2.0 to 9.5°C and 18.3 to 36.56°C respectively. Holstein-friesian cows were fitted with two iButton® temperature loggers programmed to sample every five min. The data loggers were placed vaginally using progesterone free CIDRs®. Data loggers were placed in the ear canal by first inserting the logger into the tip of a cotton infant sized sock which was then filled with polyester fiber batting. The data logger portion was placed in the ear canal and the batting packed firmly against the canal opening to insulate it from external thermal influence. Finally, the pinna of the ear was wrapped around the sock and taped closed using 3 inch wide Elastikon™ tape to hold the sock and batting in place. The resulting data was analyzed using the GLM procedure of the SAS® system. Ear canal temperature predicted vaginal temperature for the summer ($r^2 = 0.58$) and for the winter ($r^2 = 0.70$) trial. To adjust for variation due to moisture cooling the data loggers during udder washes or overhead sprinkling, the data were edited to drop outlying data points. Adjusting the data yielded a correlative value of $r^2 = 0.75$ for the summer trial and $r^2 = 0.73$ for the winter trial. Measuring ear canal temperature as described can be used for predicting vaginal temperature, although ear canal temperature may be susceptible to external influences, especially water.

Key Words: Cattle, Temperature, Data Logger

Ruminant Nutrition: Nitrogen Metabolism/Immunology

348 Effects of N solubility on metabolisable protein value of grass silage. P. Huhtanen*[1], M. Rinne[2], and J. Nousiainen[3], [1]*Cornell University*, *Ithaca, NY*, [2]*MTT-Agrifood Research*, *Finland*, [3]*Valio Ltd.*, *Finland*.

Proportion of soluble N in grass silage total N (SOLN) is related to protein degradability, especially determined in situ. Hence the concentration of metabolisable protein (MP) should decrease with higher SOLN. To test this hypothesis a meta-analysis based on 253 treatment means from 79 dairy cow production studies was conducted. In each study forage treatments (e.g. date of cut, fermentation quality and wilting) were investigated. Both the level and composition of concentrates were fixed within a study. Silage SOLN was divided into ammonia N and soluble non-ammonia N (SNAN). Silage MP was calculated as amino acids absorbed from the small intestine using constant values for ruminal protein degradability and intestinal digestibility of RUP. Mixed model regression analysis (SAS) with a random study effect (intercept random) was used to model milk protein yield (MPY), efficiency of N utilisation (NU) and milk urea N (MUN) concentration using estimated MP supply alone or together with SOLN fractions as independent variables. MPY was closely related to MP supply (residual mean squared error (RSME) of MPY adjusted for random study effect 15.7 g/d) suggesting that the simple MP model estimated the variation in silage MP precisely. MPY decreased with increasing soluble N concentration in silage, but the effect was almost completely related to ammonia N, and the effects of SNAN were non-significant and small. The effects of soluble N fractions on MUN and NU were consistent with milk production responses. The lack of MPY responses to silage SNAN concentration suggested that the division of silage N between soluble and insoluble N (excluding ammonia N) does not markedly influence silage MP concentration. In is concluded that analysis of silage SOLN has a limited value in practical feed evaluation and silage MP concentration can be estimated accurately using constant values for ruminal protein degradability and intestinal digestibility of RUP.

Key Words: Dairy Cow, Protein Utilization, Degradability

349 Ruminal metabolism of ^{15}N labelled ammonium-N and grass silage soluble non-ammonia-N. S. Ahvenjarvi*[1], A. Vanhatalo[1], P. Huhtanen[1], and A. N. Hristov[2], [1]*MTT Agrifood Research Finland*, *Jokioinen, Finland*, [2]*University of Idaho*, *Moscow*.

Ruminal metabolism of ^{15}N labelled ammonium-N and grass silage soluble N fractions was investigated in a change-over study using four dairy cows. Timothy grass (Phleum pratense) grown on a field plot was fertilized with ^{15}N enriched ammonium-N. Grass was preserved as silage, and then fractionated into soluble and insoluble fractions. Labelled ammonium-N (821 mg of ^{15}N in excess of background enrichment) and grass silage soluble N (840 mg ^{15}N) was administered into the rumen as a single dose. Grass silage soluble N fractions comprised 59 mg of ammonia-^{15}N and 781 mg of soluble non ammonia-^{15}N (SNAN). To follow the ruminal metabolism of ^{15}N-labelled N-fractions grab samples of ruminal digesta were collected at 0.5, 1.0, 1.5, 2, 3, 4, 6, 8, 11, 14, 17, 22, 27, 33, 39, 47, 55, 63 and 72 h after the dose. Digesta samples were treated with mercuric chloride, then fractionated into ammonia-N, SNAN, insoluble-N, and bacteria-N. Rumen liquid passage rate was determined using LiCoEDTA and particle passage rate was determined based on ADIN-^{15}N excretion in feces. A dynamic mechanistic model was developed to describe the ruminal N metabolism. The model comprised five ruminal compartments: grass silage SNAN, ammonia-N, bacteria-N associated with non-escapable particles, bacteria-N associated with escapable particles, and liquid associated bacteria-N. The model indicated that of ammonia-N administered into the rumen 32% disappeared by absorption, 19% escaped in the liquid phase, 14% in liquid associated bacteria-N, and 36% in particle associated bacteria-N. Of grass silage soluble N 17% was absorbed as ammonia-N, 11% escaped the rumen in liquid phase as ammonia-N, 19% escaped the rumen in liquid associated bacteria, 33% in solids associated bacteria, and 19% of grass silage SNAN escaped the rumen as undegradable feed N. In conclusion, a greater proportion of silage soluble N compared with ammonia-N is incorporated into microbial N, and a considerable proportion of silage SNAN escapes rumen degradation.

Key Words: Grass Silage, Rumen N Metabolism, Modelling

350 The aerobic stability of forage maize silage preserved with microbial inoculant with and without preservatives. J. K. Margerison*[1], S. A. Hall[2], and D. Wilde[3], [1]*Massey University*, *Palmerston North, New Zealand*, [2]*University of Plymouth*, *Plymouth, UK*, [3]*Alltech Ltd*, *Stamford, Lincs, UK*.

Forage maize (FM) was (harvested DM 29 ± 1.29 %) ensiled in experimental silos with: No additional additive and 100 ml of water / 100 kg FM (NA 0.5); No additional additive and 200 ml of water / 100 kg FM (NA 1); Sil-All fireguard at 0.25g/100kg FM (SAFS 0.5); Sil-All fireguard 0.5g/100kg FM (SAFS1); Maize All GS 0.5g/100kg FM (MAS 0.5); Maize All GS 1g/100kg FM (MAS 1). Replicate (3) silos were stored (constant 17 to 20 °C) for 30 d. On opening silage was analysed for: DM, pH, lactic acid, acetic acid, NDF, ADF, crude protein, ME and ash at 0, 24, 48, 96 and 168 h and aerobic stability (AS) was assessed. AS significantly increased in silage treated with SAFS FR and HR and MAS at FR. AS; HR (0.5) NA 29.4, SAFS 73.2, MAS 33.0, (sem 14), at FR (1) NA 41.1, SAFS 76.5, MAS 56.4, (sem 10.30). Time to maximum pH was significantly lower with additive applied at FR compared with HR, maximum pH (h); HR (0.5) 0 7.2, SAFS 7.4, MAS 6.3 (sem 0.34), FR (1), 0 7.3, SAFS 6.7, MAS 7.4 (sem 0.22). Lactic acid (g/kg DM) up to 168 hrs decreased significantly in all treatments, HR (0.5) NA -57.6, SAFS -53.3, MAS -50.7, (sem 2.01), FR (1) NA -53.2, SAFS -72.4, MAS -64.2, (sem 5.56). ME (g/Kg DM) was significantly higher at FR SAFS. ME level (g/kg DM); HR (0.5) NA 9.4, SAFS 9.4, MAS 9.5 (sem 0.03), FR (1) NA 9.4, SAFS 9.6, MAS 9.5 (sem 0.06).

Key Words: Silage, Forage Maize, Stability

351 Effect of corn hybrid and processing on ruminal and intestinal digestion using the mobile bag technique. F. W. Harrelson*[1], N. F. Meyer[1], G. E. Erickson[1], T. J. Klopfenstein[1], and W. A. Fithian[2], [1]*University of Nebraska*, *Lincoln*, [2]*Golden Harvest Seeds, Inc.*, *Waterloo, NE*.

Ruminal and post-ruminal DM and starch digestibility can be influenced by corn hybrid as well as processing method. An in situ trial, utilizing the mobile bag technique, was conducted to evaluate the effect of corn hybrid, processing, and interactions on ruminal and intestinal digestion. A finishing trial was conducted to evaluate feedlot performance and compare it with digestion characteristics. Two ruminally and duodenally fistulated Holstein steers (490 kg BW) were used in a 2×6 factorial design, including 2 processing methods (high-moisture, HMC, or dry-rolled corn, DRC) and 6 commercially available hybrids. Corn samples were composites from the finishing trial and were ground to simulate mastication (6.35 mm screen). Bags were ruminally incubated for 22 h; duodenal bags were then subjected to a simulated abomasal pepsin digestion prior to insertion, and collected in the feces. Significant interactions were observed between hybrid and processing method for ruminal and total-tract DM disappearance, as well as ruminal, post-ruminal, and total-tract starch digestibility (P<0.01). Within processing method, post-ruminal and total tract digestibilities of starch and DM were affected by hybrid (P<0.05). Ruminal starch digestion ranged from 37.5% - 42.0% for DRC and from 59.1% - 81.2% for HMC. Post-ruminal starch digestion ranged from 54.8% - 68.8% for DRC and from 78.9% - 92.8% for HMC. Total-tract starch digestion ranged from 71.6% - 81.6% for DRC and from 91.5% - 98.4% for HMC. Relationships were observed between G:F and post-ruminal starch digestibility (r=0.84), as well as total-tract starch digestibility (r=0.73). Correlations among hybrids within both processing methods were not significant. We conclude that processing method has a larger impact than hybrid. HMC showed an improvement of 13.6% to 23.6% in total-tract starch digestion compared to DRC. The results of this trial suggest that hybrid as well as processing have an impact on starch digestion.

Key Words: Corn Hybrid, Corn Processing, Starch

352 Ruminal L-dopa degradability and *in vitro* fermentation kinetics of *Mucuna pruriens* and soybean meal treated with or without L-dopa. S. K. Chikagwa-Malunga*, A. T. Adesogan, S. C. Kim, N. J. Szabo, R. C. Littell, and N. Krueger, *University of Florida*, *Gainesville*.

Mucuna pruriens (velvet bean) is an underexploited protein supplement because mucuna L-dopa causes adverse symptoms in non-ruminants but not ruminants. To understand ruminant tolerance of L-dopa, the kinetics of ruminal fermentation of mucuna seeds (M), M L-dopa, and soybean meal treated without (SB) or with 13.8% of DM of L-dopa (SBD) were measured. Ground (1 mm) samples of M (4.89 % L-dopa), and SB (Experiment 1) or SB and SBD (Experiment 2) were fermented in triplicate in buffered rumen fluid in culture bottles and headspace gas pressure was measured hourly for 24 h. Each experiment was repeated once. A non-linear exponential model was fitted to the data. Furthermore, SBD and M were fermented in triplicate for 0, 4, 8, 16, and 24 h and residual L-dopa concentration was measured. Fermentation of M vs. SB produced more ($P < 0.01$) total gas (255 vs. 97 ml/g DM), but required a longer ($P < 0.01$) lag phase (3.53 vs. 1.38 h). Fermentation of M vs. SB produced more ($P < 0.05$) total VFA (203 vs. 180 mmol/L) and butyrate (20.0 vs. 14.5 molar %), less acetate (34.7 vs. 42.9 molar %; $P < 0.10$, tendency), and a lower acetate:propionate ratio (1.35 vs. 1.87; $P < 0.05$). Addition of L-dopa to SB increased ($P < 0.01$) total gas production (85.3 vs. 173.9 ml/g DM), total VFA concentration (132 vs. 188 mmol/L) and molar % of butyrate (13.6 vs. 27.1) and isobutyrate (7.5 vs. 8.2; $P < 0.10$, tendency), but reduced ($P < 0.05$) the fermentation rate (0.09 vs. 0.07 ml/h). The concentration of L-dopa in fermented M and SBD decreased by 53 and 47%, respectively. In conclusion, M was more extensively fermented than SB, and degradation of L-dopa by ruminal microbes was confirmed. Adding L-dopa to SB did not impair ruminal fermentation.

Key Words: Mucuna L-dopa, Soybean Meal, Gas Production

353 Study internal molecular-structural changes of flaxseeds affected by dry roasting at various conditions in relation to rumen degradation kinetics of dairy cattle. K. Doiron* and P. Yu, *University of Saskatchewan*, *Saskatoon, SK, Canada*.

The objective of this study was to reveal internal molecular-structural changes of flaxseed (cv. Vimy) affected by dry roasting at the temperature of 120°C for 20 (T1), 40 (T2) and 60 min (T3), respectively, in relation to rumen degradation kinetics in dairy cattle. The internal structural changes of roasted flaxseeds were determined by globar-sourced FTIR spectroscopy in the mid-IR region from 4000 to 400 cm-1 and were analysed using Cluster (CLA) and principal component analysis (PCA). The rate and extend of rumen degradation of the raw (T0) and roasted flaxseeds (T1, T2, and T3) was determined using in situ nylon bag technique. The hypothesis of this study was that the roasting changes the flaxseed inherent structures and rumen degradation kinetics. The results showed that dry roasting did not affect

Kd of DM and EE with average of 7.04 and 19.77%/h, respectively (P>0.05), but decreased (P<0.05) Kd of CP from 7.20 to 5.54%/h. Dry roasting reduced (P<0.05) ED of DM and CP from 571 to 532, and 139 to 109 g/kg DM, respectively without affecting ED of EE with average of 215 g/kg. With the FTIR spectroscopy and CLA and PCA spectral analyses, the internal molecular-structural changed were revealed. The results showed that in the fingerprint region (1800-800 cm-1), protein amides (1715-1485 cm-1) and carbohydrate region (1200-800 cm-1), the cluster of the raw (T0) and roasted flaxseed (T3) were significantly different, indicted the internal structures were different between the raw and roasted flaxseed. The roasting affected both protein region and carbohydrate region. Further study is needed to understand the relationship between internal molecular structural changes and nutrient availability in ruminants.

Key Words: Molecular Structure, Raw and Roasted Flaxseeds, Nutrient Availability

354 Microbial characteristics, microbial nitrogen flow, and urinary purine derivative excretion in steers fed at two levels of intake. G. I. Crawford*, M. K. Luebbe, J. R. Benton, T. J. Klopfenstein, and G. E. Erickson, *University of Nebraska*, *Lincoln*.

Ruminally and duodenally fistulated Holstein steers (569 ± 40 kg) were fed at two levels of intake to determine purine:N ratio of ruminal microbes, endogenous purine derivative (PD) contribution to urinary PD excretion, the effect of spot sampling time on ratios of urinary PD to creatinine (PD:C), and the relationship between urinary PD excretion and duodenal purine flow. Steers were arranged in a crossover design and were fed 40 or 85% of their previously determined individual ad-libitum DMI of a diet consisting of 70% high-moisture corn, 20% corn bran, 5% alfalfa hay, and 5% dry supplement. The diet was provided by automatic feeders in equal portions delivered every 4 h. On average, steers consumed 5.3 and 11.3 kg DM/d with the 40 and 85% intake levels, respectively. Microbial purine:N ratio (g:g) did not differ (P = 0.59) between intake levels, and ranged from 0.127 to 0.251 with an overall average of 0.205. Urinary PD:C and microbial CP (MCP) flow estimated from duodenal purine flow were both greater (P < 0.05) with the 85% intake level than the 40% intake level. Microbial efficiency, measured as either g of CP/kg OM truly digested (P = 0.08) or g of CP/kg TDN intake (P = 0.05), increased with the 85% intake level compared with the 40% intake level. Urinary PD excretion (mmol) was related (P < 0.05; r^2 = 0.603) to duodenal purine flow (mmol), and resulted in an equation of 0.412× + 57.774. This implies a 41.2% recovery of absorbed purines and an endogenous PD contribution of 501 µmol/kg BW $^{0.75}$. Diurnal variation in urinary PD:C ratio was not evident (P = 0.86) when diets were fed in six evenly spaced and equal portions/d. Results from this experiment suggest that microbial purine:N ratio is not affected by level of feed intake, and that urine spot samples may be used to estimate relative differences in MCP flow, although low recoveries of duodenal purines may occur.

Key Words: Microbial Protein, Purine Derivatives, Steers

355 The incidence of liver abscessation in pasture based bull beef systems of New Zealand. J. Gibbs*, J. Laporte-Uribe, C. Trotter, and J. Noel, *Dairy Science Group, Agriculture and Life Sciences, Lincoln University*, *Canterbury, New Zealand*.

Bull beef systems for manufacturing grade beef in New Zealand (NZ) account for almost 50% of the national beef output. Dairy calves comprise approximately 85% of bulls, with suckled beef breeds the remainder. From weaning stock are almost entirely pasture fed until target slaughter carcass weight (CW) 240-270 kg at 18-24m. This has led to intensified grazing management in the last decade. Liver abscessation in cattle is usually associated with cereal feeding systems, and was traditionally uncommon in pasture based NZ livestock, but anecdotal industry reports of slaughter bulls and clinical cases in dairy cows suggest the incidence is sharply increasing. There is no existing research on liver abscessation in NZ. This project sought to establish the mean, breed and seasonal incidences and CW effect of liver abscesses at slaughter in NZ bulls. A large commercial database of source farm, breed, CW, liver abscess scores (absent, mild, moderate or severe) from all bulls slaughtered in that operation between 2000 and 2005 was analysed. The mean incidence of abscessation over all years was 10% (range: 9-13%), and increased across the years studied. The incidence increased each month across spring and summer and declined in autumn and winter. There was great variation in incidence between farms (range: 2-45%). Dairy breeds had a twofold greater mean incidence (9.3%) compared to beef breeds (4.6%), with Friesians the highest at 11.2%. Severe grade comprised 66% of all abscess cases. In each year, the range of mean CW for each liver grade group was <20kg, and mean CW was lowest in the severe grade, greater for absent grade, and highest for mild or moderate grades. Conclusions: Liver abscess incidence at slaughter appears to be increasing in NZ beef bulls, and is at similar levels to grain fed cattle systems internationally. Dairy breeds have a higher incidence, and there is a reduction in CW only with severe grade. Concurrent research in NZ suggesting the traditional understanding of rumen function in pasture fed cattle is inadequate for contemporary high intake dairy cows on high quality pastures under intensive management may help explain these findings.

Key Words: Liver Abscess, Dairy Beef

356 Metaphylaxis therapy interacts with temperament to influence performance of growing beef steers. Z. D. Paddock*[1], J. E. Sawyer[1], G. E. Carstens[1], R. R. Gomez[1], B. M. Bourg[1], D. K. Lunt[2], S. A. Moore[3], and D. S. DeLaney[3], [1]*Texas A&M University*, *College Station*, [2]*Texas A&M University*, *McGregor*, [3]*King Ranch*, *Kingsville, TX*.

The effects of metaphylactic therapy on growth, intake, and feeding behavior traits were evaluated using 119 Santa Gertrudis steers (initial BW 265 ± 24 kg). Steers were preconditioned at the source of origin, transported 550 km, and allowed to rest overnight before processing. At processing, steers were weighed, blocked by weight, and randomly assigned within weight block to receive 1.5 mL/45.5 kg BW ceftiofur crystalline free acid (EXC) administered at the base of the ear, or to receive no antimicrobial (CON). Steers within blocks receiving both treatments resided in common pens. Mean exit velocity (EV) was measured on d 0 and 28, as rate of distance traveled exiting from a chute, and used as an objective measure of temperament. Steers were weighed on d 0, 14, and 28. Meal frequency, duration, and DMI were recorded continuously using a GrowSafe feeding system. Data were analyzed as a mixed model with block as a random effect, treatment as a fixed effect, and EV as a covariate. An unequal slopes model was fit for treatment by EV interactions, with treatment differences tested at the mean EV and at ± 1 SD. Meal frequency increased with EV for EXC steers, but was unaffected by EV in CON steers (P = 0.02). Meal

duration was similar for steers with low EV, but decreased at a greater rate for CON than EXC steers (P = 0.01); at high EV, EXC steers had greater meal duration. Intake declined with increasing EV in CON steers, but was unaffected by EV in EXC steers (P = 0.01). High EV steers treated with EXC consumed more feed than high EV steers that were untreated. Interactions between EV and metaphylaxis resulted in differences in ADG from d 0 to 14 (P < 0.01) and d 0 to 28 (P = 0.01). At low EV, ADG was similar among treatments, but at mean or high EV, steers treated with EXC had greater ADG, and treatment differences increased with EV. Only one steer was clinically morbid during this trial. Results demonstrate that metaphylaxis therapy resulted in positive effects on ADG, DMI and feeding behavior during the receiving period for steers with high EV, whereas, metaphylaxis therapy had less utility for steers with low EV.

Key Words: Metaphylaxis, Temperament, Morbidity

357 Effects of *Mannheimia haemolytica* challenge on blood flow and net splanchnic flux of amino acids in fed or fasted steers. L. O. Burciaga-Robles*[1], C. R. Krehbiel[1], D. L. Step[2], C. A. Loest[4], L. Chen[4], M. Montelongo[2], A. W. Confer[2], J. N. Gilliam[2], B. P. Holland[1], and C. L. Goad[3], [1]*Department of Animal Science*, [2]*Department of Health and Veterinary Sciences*, [3]*Department of Statistics, Oklahoma State University*, *Stillwater, OK*, [4]*Department of Animal and Range Sciences, New Mexico State University*, *Las Cruces, NM*.

This experiment evaluated blood flow and net splanchnic flux of AA during a bovine respiratory disease (BRD) challenge. Twenty two steers (BW = 320±24 kg) with chronic catheters to measure blood flow and net flux across the portal drained viscera (PDV) and liver were used. Arterial, portal, and hepatic blood samples were collected at 1.5-h intervals on d 0, 1, 2, and 3. Treatments (2×2 factorial arrangement) applied to steers were: 1) ad libitum feeding and not challenged (FED/CON); 2) ad libitum feeding and challenged (d 0) with *M. haemolytica* via a tracheal tube (FED/CH); 3) 72-h fasting and not challenged (FAST/CON); 4) 72-h fasting and challenged (FAST/CH). All data were analyzed using repeated measures and first-order autoregressive covariance structure. Diet affected (P < 0.05) portal, hepatic, and arterial blood flow, which were greater for FED compared with FAST steers (461, 708, and 170 vs 427, 522, and 97 L/h, respectively). Challenge increased haptoglobin concentration, and was greater for FAST/CH than FAST/CON steers (Diet×Challenge; P = 0.004). Concentration of total AA was greater (P = 0.01; 1,966 vs. 1,645 μM) in CON than in CH steers. In addition, there was a net removal of total AA (-117.8 mmol/h) by liver of CH and a net release for CON steers (21.5 mmol/h; P = 0.03). Although arterial concentrations of essential AA were not different (P = 0.22), CH tended (P = 0.11) to have a greater net removal (-65.2 vs. -22.3 mmol/h) of essential AA by the liver than CON steers. Nonessential AA concentration was greater (P = 0.001) for CON (1,173 μM) vs. CH (924 μM) steers. Similar to total AA, there was a net removal of nonessential AA (-52.8 mmol/h) by the liver for CH and a net release for CON steers (42.5 mmol/L; P = 0.02). These results suggest that BRD increases removal of AA by the liver of steers, potentially in support of an acute phase response.

Key Words: *Mannheimia Haemolytica*, Amino Acids, Steers

358 Effects of endotoxin and dietary protein on N metabolism, and serum cortisol and haptoglobin in growing beef steers. J. W. Waggoner*, C. A. Loest, J. L. Turner, C. P. Mathis, K. K. Kane, D. M. Hallford, and M. K. Petersen, *New Mexico State University*, *Las Cruces*.

Bacterial lipopolysaccharide (LPS) stimulates the immune system and mimics metabolic responses of gram(-) bacterial infection in cattle. Effects of LPS and dietary protein on N metabolism and serum concentrations of cortisol and haptoglobin (HAPT) in 24 steers (250 ± 2.8 kg BW) were studied. Treatments were a 2 × 3 factorial of LPS (0 vs 1.5 μg/kg BW; **-LPS** vs **+LPS**) and diets containing (DM basis): 1) 14.5% CP, 11.6% DIP and 2.9% UIP (**CP14.5CON**); 2) 16% CP, 13.3% DIP and 2.7% UIP (**CP16DIP**); and 3) 16% CP, 11.3% DIP and 4.7% UIP (**CP16UIP**). Source of DIP was casein and sources of UIP were fish meal and corn gluten meal. Steers were adapted to diets (±1.2 Mcal/kg NE_g; DM fed = 1.8% BW) for 14 d, and were infused (i.v. 1 mL/min) with LPS (in 100 mL saline) on d 15. Blood samples were collected before LPS infusion and every 2 h for 12 h thereafter. Feces, urine, and orts were collected for 5 d starting d 16 and composited. Serum cortisol and HAPT increased (P ≤ 0.05) in response to +LPS, but were not affected by diet. Serum cortisol of +LPS steers increased at 2 h, peaked at 4 h (5.4 vs 75.6 ng/mL for -LPS vs +LPS), and remained elevated for 12 h (P ≤ 0.05); serum HAPT of +LPS steers were elevated at 4, 6, 10, and 12 h (P ≤ 0.05). Dietary DM and N intakes were lower (P ≤0.05) for +LPS vs -LPS steers, and N intakes were greater (P ≤ 0.05) for higher CP diets. There was a LPS × diet interaction (P = 0.06) for N retained (% of intake); diet did not alter N retention of -LPS steers, but +LPS steers retained more N when fed CP16DIP and CP16UIP than CP14.5CON. These results imply that growing steers exposed to endotoxin may require greater dietary protein concentrations to offset altered intake and metabolic demand.

Table 1.

	-LPS			+LPS			
Nitrogen, g/d	CP14.5-CON	CP16-DIP	CP16-UIP	CP14.5-CON	CP16-DIP	CP16 UIP	SEM
Intake[a,b]	104	118	116	98	107	110	2.7
Feces	36	39	36	33	30	36	2.6
Urine[c]	42	53	49	52	52	50	2.8
Retained[a,b]	26	26	31	13	25	24	3.1
N Retention, % intake[a,c]	25	22	27	13	23	22	2.7

[a]LPS effect (P ≤ 0.05).

[b]Diet effect (P ≤ 0.05).

[c]LPS × Diet effect (P ≤ 0.10).

Key Words: Stress, Protein, Cattle

359 Effect of dietary boron on the immune function of growing steers. R. S. Fry*, K. E. Lloyd, S. K. Jacobi, and J. W. Spears, *North Carolina State University*, *Raleigh*.

An experiment was conducted to determine the effects of dietary boron (B) on the performance and immune response of growing steers. Thirty-six Angus and Angus-cross steers (average initial BW 270

kg) were blocked by weight within breed and randomly assigned to treatments. Treatments consisted of: 1) control (no supplemental B), 2) 5 mg/kg of supplemental B, 3) 50 mg/kg of supplemental B. Supplemental B was supplied from sodium borate. The control diet contained 10.2 mg/kg of B. Steers were housed in slotted floor pens with 2 animals per pen. Weights were taken at 14 d intervals. Jugular blood was obtained from steers on either d 42 or 44 for assessment of lymphocyte blastogenesis. One-half of the steers in each treatment group were sampled on each date. Supplemental B tended ($P = 0.12$) to increase the blastogenic response of B lymphocytes to pokeweed mitogen, but did not affect proliferation of T lymphocytes when stimulated with concanavalin A or phytohaemagglutinin (PHA). Humoral immunity was assessed on d 49 by injecting steers IM with a pig red blood cell (PRBC) suspension. Blood samples were collected at d 0, 7, 14, and 21 following PRBC administration for determination of antibody titers. Specific anti-PRBC IgG titers were affected by a treatment × day interaction ($P < 0.07$). Boron supplemented steers had greater ($P < 0.05$) IgG titers than controls on d 7 but not on d 14 or 21 post-injection. Cell-mediated immune response was also evaluated following an intradermal injection of PHA on d 77 of the study. Skinfold thickness following PHA injection was not affected by dietary B. Performance of steers during the 77 d study was not affected by dietary B. Results of this study indicate that supplemental B did not affect the performance of growing steers, but may affect the immune response.

Key Words: Cattle, Boron, Immunity

Ruminant Nutrition: Opportunities to Improve Forage Utilization and Rumen Function

360 Utilizing fats and carbohydrates in forage-based diets for lactating cows. M. S. Allen*, *Michigan State University*, *East Lansing*.

Forages contain relatively high concentrations of fiber that is slowly and incompletely digested, limiting energy intake for high producing cows. Therefore, cows with high energy requirements are fed forage-based diets supplemented with feeds containing readily digested carbohydrates and (or) fats. However, specific fuels can have physiological effects that alter intake and utilization of dietary energy. The profile and pattern of absorption of fuels depend on the composition of the diet, including not only its chemical composition, but physical characteristics which influence ruminal fermentation and dynamics. Rapidly fermented carbohydrates and some fat sources can decrease feed intake, ruminal fiber digestibility, efficiency of microbial protein production, and increase flow of intermediates from fatty acid biohydrogenation from the rumen. Physiological effects of specific fuels might involve alteration of hormone or enzyme concentrations affecting gluconeogenesis, lipolysis and lipogenesis in tissues, fat and protein production by the mammary gland, gut motility, or feeding behavior. These physiological effects can influence energy intake, yield of milk and milk components, and body condition independent of the energy contributed by the fuel itself. Furthermore, physiological and production responses to specific fuels are dependent upon animal characteristics (e.g. glucose demand, lipolytic state, adiposity). Therefore, physiological effects of energy concentrates must be considered when formulating diets rather than formulating for energy density alone. The objective of this presentation to discuss physiological effects of specific fuels and how these effects can be utilized to optimize diets for cows in different stages of lactation.

Key Words: Feed Intake, Energy Partitioning, Physiological State

361 The role of ionophores in improving utilization of forage and forage-based diets. V. Fellner*, *North Carolina State University*, *Raleigh*.

Ionophores have been routinely added to non-lactating ruminant diets to improve animal performance and efficiency of feed utilization. Although several ionophores have received FDA approval, the most common and widely studied ionophore is monensin that is now also approved for use in lactating cow rations. Benefits of ionophores are attributed, almost exclusively, to changes that occur in the rumen. A shift in the ruminal acetate:propionate ratio, with a concomitant decrease in methane and ammonia, are classical responses to feeding ionophores. The magnitude of change can vary, however, and is not always predictable. Preferential binding of ionophores to specific ions, level of ionophore inclusion in the diet, and dietary composition are some of the reported factors contributing to the variability in ionophore action. Managing the diet is perhaps the most critical factor in maximizing the benefit of ionophores, irrespective of type or level of inclusion. With high forage diets a lower dose of ionophore elicits maximal ruminal response. This is in contrast to high concentrate diets that typically provide for a greater ionophore response at higher doses. Generally, the fiber digesting microbes are most sensitive to ionophores whereas starch fermenters tend to be more resistant. Yet, a decrease in nutrient digestibility, specifically fiber, is more pronounced in diets having low, rather than high forage content. Changing the forage:concentrate ratio alters several factors, including intakes, passage rates and pH, all of which impact microbial shifts. Among the predominant fibrolytic bacteria, some that may even be resistant to ionophores, there is considerable difference in kinetics of microbial growth in response to ionophores. The major starch utilizing bacteria are less sensitive to ionophores but seem to alter their metabolism with source and level of starch. The driving force in ruminant production is energy whether it's from grain or forage. Varying dietary ingredients varies the substrate for the microbes as well as ruminal kinetics, both of which interact to determine the response to ionophores.

Key Words: Ionophore, Forage, Rumen

362 Lactating dairy cow responses to yeast products. P. H. Robinson*[1] and L. J. Erasmus[2], [1]*University of California*, *Davis*, [2]*University of Pretoria*, *Pretoria, South Africa*.

Studies with lactating Holstein cows, from peer review publications, were used to determine responses to feeding Saccharomyces cerevisiae yeast products (YP) from diet composition. The 21 studies reflected 6 YP, with 3 used in 6, and 3 used in 1 study. In spite of differences (i.e. NDF/starch; P<.05) in diets, and milk yield, milk energy output and milk fat % (P<.05) among control group cows (CGC) in studies of the 3 major YP, proportional milk, milk component, milk energy and DMI responses of cows to these YP did not differ. Thus all 21 studies were pooled and simple correlations showed that higher diet NDF or

ADF levels reduced responses to any YP, while higher diet starch had little impact. Increased milk and milk energy output of CGC reduced benefits of YP, and results suggest that YP milk yield response was absolute (~0.9 kg/cow/d) and decreased proportional to CGC milk yield as that increased. Multiple correlation analysis showed that only milk and milk protein yield responses to YP could be acceptably, but modestly (r^2 = .52 and .45 respectively), predicted based on milk yield of CGC and diet NDF and starch levels (both negative). Precision of predictions appeared compromised by unequal allocation of NEl between milk and BW change among studies. A reduced study set (i.e. 10), with BW and BW change reported, allowed % response in NEl output to feeding YP to be calculated. Results suggest that % increase in NEl output to YP increased modestly in diets with higher starch levels and decreased in diets with higher NDF levels, although changes were more positive as NDF fermentability increased. While findings support 2 currently proposed modes of action of Saccharomyces cerevisiae YP that suggest that they stimulate rumen microbes to increase fermentability of fiber and/or allow rumen microbes to more effectively metabolize end-products of ruminal starch fermentation, benefits in milk, milk energy and NEl output to YP were modest (i.e., 2.7, 3.1 and 5.3% respectively). Future studies in feeding YP should consider dose response designs at YP feeding levels higher than those in past studies, as well as report BW and BW change, in order to allow YP impacts on animal energetics to be determined.

Key Words: Yeast, Lactation

363 Enzymes to improve forage utilization by ruminants: What's on the horizon. K. A. Beauchemin* and J. -S. Eun, *Agriculture and Agri-Food Canada*, *Lethbridge, AB, Canada*.

This paper reviews the research on the development of enzyme additives for ruminants and attempts to provide a rationale for enzyme selection with emphasis on future research needs and opportunities. Ruminant feed enzyme additives are concentrated fermentation products with specific enzyme activities, primarily hemicellulases and cellulases. Enzyme additives have significant potential to improve fiber digestion in cattle, thereby enhancing feed utilization and animal performance. Enzymes help bridge the gap between actual digestibility of the feed in vivo and the potential digestibility of the feed that would occur under ideal conditions. However, in previous research, the response to enzyme additives has been variable because many of the products used were not specifically formulated for ruminants. The optimum array of enzymic activities in products designed for ruminants depends mainly on forage composition. In vitro assays that reflect conditions in the rumen and measure fiber degradability can be used to identify effective enzyme candidates and optimum dose rates. Recent studies indicate that, depending on the forage, about 50% of the improvement in in vitro fiber degradability due to added feed enzymes can be predicted from the main enzymic activities provided. Method of providing the enzyme additive to the animal must be also considered. Applying a liquid solution of enzymes to the feed allows the enzyme to bind to the target substrate, thereby increasing the resistance of the enzymes to proteolysis within the rumen and facilitating a pre-ingestive attack of the enzymes upon the plant fiber. Enzyme additives provide cattle producers the opportunity to feed higher fiber diets, thereby minimizing digestive upsets associated with feeding higher grain diets while still maintaining productive performance. The challenge is to develop a better understanding of the mode of action and the critical enzyme activities needed, such that product formulations and application methods and rates can be tailored to elicit the desired response at minimal cost.

Key Words: Enzymes, Fiber Digestion, Feed Additive

Teaching/Undergraduate & Graduate Education: Enhancing the Undergraduate Learning Experience in Animal Agriculture, Through the Integration of Teaching and Research

364 Enhancing learning through inquiry. B. Wuetherick*, *University of Alberta*, *Edmonton, Alberta, Canada*.

Almost two decades ago Ernest Boyer called on educators to ″move beyond the tired old research versus teaching debate.″ That has resulted in several studies exploring the interrelation and integration of teaching and research in higher education in the North American, Europe and Australasia. Over a decade ago a well-known meta-analysis was conducted that explored commonly used measures of excellent teaching and research and demonstrated that there was at best only a minor positive correlation between them. The researchers concluded that it would be far more useful to investigate ways to increase the relationship than to try to insist that the status quo is acceptable. That was followed in 1998 by the well-known Boyer Commission, which criticized the current higher education system in the US and called on universities to make research-based learning the standard throughout undergraduate education. Undergraduate education is intended to furnish students with both generic and discipline specific skills, including inquiry and research skills, in preparation for a supercomplex, knowledge-based economy. Recent shifts toward a research-based curriculum have been attempting to provide this. Questions continue to be asked, however, about what it means to bring teaching and research together effectively to benefit undergraduate student learning. Recently attempts have been made to conceptualize the integration of teaching and research in order to help shape the debate about how to move forward with making research-based learning the standard. This introduction to the symposium ″Enhancing the Undergraduate Learning Experience in Animal Agriculture, Through the Integration of Teaching and Research″ will explore different conceptions of the integration of teaching and research and will set the stage for further discussion by the co-presenters.

Key Words: Inquiry-Based Learning, Undergraduate Research, Research-Based Teaching and Learning

365 Why should we integrate our teaching and research? C. Colbeck*, *The Pennsylvania State University*, *University Park*.

Actual synergies between teaching and research are masked by institutional evaluation practices that fragment academic roles and

by endless debates about how these roles conflict. To ascertain how academics integrate teaching and research and why they should, academics were observed on the job for hundreds of hours. On average, they integrate teaching and research around one-fifth of their work time. Academics do so as they: 1) teach students how to conduct disciplinary research in courses for academic credit or in out-of-class settings, 2) teach their current disciplinary research in the classroom, or prepare for class and for research presentations or publications using the same sources, 3) engage in scholarly inquiry about their own teaching and their studentsâ€™ learning, and 4) conduct public scholarship, applying disciplinary expertise in partnership with community members and students to address public issues. Such teaching-research integration benefits students, academics, institutions and the profession. Across many varied disciplines, students say they learn more when their instructors discuss research and real-world problems and provide opportunities to solve meaningful ill-defined problems. When academics focus on synergies rather than on conflicts between their roles, they report they enhance their teaching effectiveness and research productivity while using their time more efficiently. Similarly, joint production of teaching and research is efficient and cost effective for colleges and universities. Finally, an overall integrated approach to scholarly work may retard creeping deprofessionalization of academic work that is occurring as it is subdivided into separate tasks performed by different people in increasingly bureaucratic institutions. Synergies between research, teaching, and community service are better realized by complex professionals who are able to bring their research into the classroom, engage students in inquiry, explore systematically what works with their own teaching and studentsâ€™ learning, and partner with students and community members to develop new knowledge that serves the public good.

Key Words: Teaching, Research, Education

366 Integrating research and teaching in an introductory course setting: There's a heifer in your tank. F. E. Robinson*, N. J. Wolanski, B. Wuetherick, and S. Varnhagen, *University of Alberta*, *Edmonton, AB, Canada*.

Educators have presented reasons why the integration of research and teaching has not progressed as fast in freshman courses as it has in senior capstone courses. Typically, first-year courses have many students with a very heterogeneous background with limited knowledge of the discipline. The emphasis in introductory courses is mostly on content, rather than on process, as the learning begins with details and works up to the big picture. Nonetheless, entry level students can work very effectively in groups to achieve many of the objectives of senior level inquiry-based programs. In particular, group work, oral and written communication, can form a key component of corner-stone courses and also build a valuable sense of community. A program initiated at the University of Alberta has worked to engage students through inquiry of both big picture and small picture views of animal agriculture. Since 2004, ″There's a Heifer in Your Tank″ has evolved with groups of students ″answering questions you didn't know you had about animal agriculture″. Students have experienced public forum presentations with 350 to 700 people in attendance as quirky facets of animal production, welfare, and food processing are communicated with multi-media, drama and music. Short magazine style reports have been produced and released to the public and print media. Linkages with grades 4-7 students have provided a platform for student recruitment in urban and rural settings. The success of this program has been measured in terms of increased enrolment, enhanced public media interest, and very high levels of current and alumni student engagement. Graduate students serve as teaching assistants and senior undergraduates serve as ″learning coaches″ to provide support to the class. Both these groups attend most lectures and position themselves around the class in a ″Surround Learning″ model. The program has become a focal point of academic interaction of the Faculty with prospective students, the public and the Agri-Food industry.

Key Words: Undergraduate Teaching, Group Projects, Introductory Courses

367 Integrating research and teaching in a senior course setting. W. L. Hurley*, *University of Illinois*, *Urbana*.

The relationship between research and teaching at the college level provides unique opportunities for enriching the undergraduate learning environment. The desire to integrate research and inquiry into the undergraduate experience arises in part through recognition of the extensive learning that occurs when conducting research. Encouraging undergraduate students to conduct structured research projects in a laboratory or field setting provides this experience for a subset of our undergraduates. However, the goal is to integrate the inquiry process more broadly into student learning. This requires providing students the opportunity within our courses to more fully understand the inquiry process and to practice the skills that allow them to succeed. Inquiry is about asking questions, investigating potential solutions, creating new knowledge from information gathered, discussing experiences and outcomes, and reflecting on the new knowledge, which in turn generates new questions. Even at the senior level, many students have had only fragmented and discontinuous experiences practicing skills needed to successfully navigate the inquiry process. When a course focuses primarily on delivery of course content the expectation often is that students will achieve an identical knowledge outcome from that content. Students should be given the opportunity to pursue the inquiry process in an environment that allows them to achieve individual knowledge outcomes. The instructor's role becomes one of facilitator of inquiry and guiding students through the process. Effective integration of inquiry into courses can result in greater understanding of what has been learned, as well as enhancement of critical thinking and other skills employed during the inquiry process. Examples to be presented include active and collaborative learning approaches, encouraging student creation of course content, expanding the learning beyond the classroom, effective use of educational technologies, and alternative approaches to assessment of learning, each of which may help instructors facilitate integrating more inquiry based learning into their courses.

Key Words: Teaching, Undergraduate, Inquiry

368 Teaching opportunities for graduate students: Who benefits? N. J. Wolanski* and F. E. Robinson, *University of Alberta*, *Edmonton, Alberta, Canada*.

Enabling graduate students as teaching assistants can improve the educational process for undergraduate students as well as academics. Allowing graduate students to work as educators helps to further develop graduates as successful teachers. As class sizes increase,

and as undergraduate students embark on research, graduate students can be intermediates between large undergraduate classes and the professor. Graduates who are actively conducting research understand the plight of the over worked researcher/professor. Graduate students also display a strong commitment to assisting undergraduates in understanding course material. At the University of Alberta, student based learning where they cooperate to solve complex real world problems has replaced simple memorization. In order to facilitate this type of learning, graduate students and senior level undergraduates are utilized to assist junior students with solving inquiry type problems. Senior students have a broad range of experiences which allows for the integration of both scientific knowledge and life experiences to provide undergraduates with necessary insights to solve these complex issues. When undergraduates desire a greater proportion of an academics time tasks such as research and administrative responsibilities are sacrificed however, teaching assistants can field questions and answer concerns as they arise. Teaching assistants can address student concerns and make undergraduates cognizant of the many responsibilities of an academic; therefore graduate student's can bridge the gap between busy academics and concerned undergraduates. While assisting in the educational process graduate students have opportunities to teach, receive mentored training, and are eligible for graduate student teaching awards. Some of the negative consequences of a teaching appointment include increased work loads which may delay graduation or increase graduate student stress. A teaching appointment can provide necessary financial support during a graduate degree and, the sense of satisfaction from a positive teaching appointment may propel graduates to investigate careers in education.

Key Words: Graduate Teaching Assistant, Undergraduate Research, Teaching Experience

369 Researching teaching. C. K. Varnhagen*, *University of Alberta*, *Edmonton, Alberta, Canada*.

As animal scientists, we apply a range of methodologies to address research technique and solve applied problems. As teachers, however, we seldom even examine our teaching critically and objectively, much less scientifically. A key component of integrating teaching and research is researching teaching. Researching teaching involves applying the scientific method to understanding and improving teaching and learning. One viewpoint from which to consider research on teaching is as a pyramid of empirical evidence regarding teaching and learning. According to this conception, we can organize research on teaching according increasingly sophisticated scholarly and empirically based methods. At the base of the pyramid is scholarly reflection involving a critical examination of personal goals and objectives for teaching and learning and rational consideration of effectiveness of teaching methods. The next level in the pyramid of research on teaching is rational ideas and opinions. This involves reflecting on and applying the often empirically based ideas and opinions expressed by others. Moving up through the levels of the pyramid are increasingly controlled and generalizable methods for empirically investigating teaching and learning, from case studies to correlational and cohort analyses, to quasi-experimental designs to meta-analyses of a wide range of studies conducted at a wide range of institutions. Work at these levels of the pyramid o generates presentable and publishable results that stimulate scholarly discussion among researchers and educators and promote research-based teaching methods. Adopting a pyramid of evidence approach to research on teaching brings these often-disregarded endeavors into scholarly focus at the same time as documenting important improvements and innovations in teaching and learning.

Key Words: Research, Teaching, Evidence

ADSA-SAD Undergraduate Competition - Original Research

370 Probiotic ice cream manufactured with honey, a natural sweetener with several health benefits. A. Greenbaum*[1] and K. J. Aryana[2], [1]*Louisiana State University*, *Baton Rouge*, [2]*Louisiana State University Agricultural Center*, *Baton Rouge*.

Lactobacillus acidophilus offers several health advantages. Honey is a sweetener which aids in the prevention of seasonal allergies, is effective in treatment of stomach ulcers. Honey is also a good source of antioxidants which play a big role in prevention of cancer and heart disease. Darker the honey more is the level of antioxidants. Moreover, honey increases counts of probiotics namely bifidobacteria and lactobacilli in the colon. Objective was to study the effect of light, amber colored and dark honey on the physico-chemical, microbiological and sensory characteristics of probiotic ice creams. Ice cream mixes were made using light, amber colored and dark honeys separately. Mixes were pasteurized, homogenized, cooled and aged overnight. Mixes were inoculated with Lactobacillus acidophilus in the amount of 0.7% w/v mix. Mixes were flavored with vanilla and frozen using a batch freezer. Product manufacture was replicated three times. The mean L_* (lightness) value of ice creams mixes with light and dark honeys were 55 and 25 respectively. The mixes with the darker honeys had a lower pH (6.5) compared to the lighter honeys (6.7). There were no differences in the viscosities of the mixes. Neither were there any differences in lactobacilli counts of the ice creams with the use of different colored honeys. Average meltdown volume in 1 hour for the ice creams with darker honey was significantly more (76 mL) compared to the ice creams with light honeys (44 mL). As expected the lighter honey resulted in lighter colored ice creams and the dark honeys resulted in darker ice creams. Use of different colored honeys altered some characteristics of the probiotic ice creams.

Key Words: Honey, Sweetener, Ice Cream

371 Determining the efficacy of infra-red technology as part of a mastitis preventitive routine. D. M. Tearney*[1], T. R. Lane[2], D. R. Bray[1], and R. P. Natzke[1], [1]*University of Florida*, *Gainesville*, [2]*Spirit Solutions*, *Dayton, OH*.

Mastitis is the major economic loss in the dairy industry today. To ameliorate this problem, a good routine of early mastitis detection and adjustment of management is needed. Infra-red technology is a promising tool for early mastitis detection. Hand-held infra-red cameras may become a convenient tool to measure the temperature of cows instantaneously. The ultimate goal of the project is to be able to integrate routine recording of cow temperatures as a tool to monitor udder health. Therefore, the primary objective of this preliminary study was to find an area on the body that would accurately reflect the rectal temperature. The rectal temperatures of 200 cows were compared to

the IR camera measurements of: flank, rear udder, side udder, eyes, and shoulder. Prior to data collection, the IR device was calibrated by using a can filled with hot water and comparing a mercury thermometer reading with the IR camera reading. Data was recorded and analyzed using Microsoft's Excel program. All body areas had relatively low correlations with rectal temperature. The rear udder provided the highest correlation with rectal temperature. The side udder was shown as a close second. While the correlation between rectal temperature and rear udder temperature was relatively low, it is quite possible that an udder infection remains localized and thus does not always result in an elevated rectal temperature. Further investigation is needed to correlate the rear and/or side udder temperature with the somatic cell count of the milk.

372 Genetic analysis of the relationship between ketosis and milk fat in Holsteins. E. E. Yeiser*[1], C. D. Dechow[1], J. Vallimont[1], C. G. Sattler[2], and J. S. Clay[3], [1]*The Pennsylvania State University*, *University Park*, [2]*Select Sires, Inc.*, *Plain City, OH*, [3]*Dairy Records Management System*, *Raleigh, NC*.

Excessive body fat mobilization during periods of early lactation negative energy balance is associated with metabolic disorders and high milk-fat percentages. The objectives of this study are to estimate genetic parameters for ketosis and to estimate the genetic relationship of ketosis with the following milk-fat percentage (MFP) traits: fat % on test-day 1 (F1), ratio of fat % on test day 1 to fat % on test day 3 (F1/F3), fat to protein ratio on test-day 1 (F1/P1), average fat to protein ratio across lactation (F/P), and fat % for the entire lactation (F). Test date, days in milk, fat %, protein % and disease records from progeny test herds that use PCDART to record health events were provided by Dairy Records Management System (Raleigh, NC). There were 19,201 ketosis observations for cows calving between 20 to 120 months of age in lactations 1 through 5. A total of 74,479 observations were available for F1 and F1/P1; 85,304 observations were available for F and F/P; and 57,995 observations were available for F1/F3. Two-trait animal models with ketosis and one MFP trait were analyzed using ASReml. The fixed effects were contemporary group and age within parity. Contemporary groups were herd-year-season of calving for ketosis, F, and F/P, and herd-test-date for F1, F1/F3, and F1/P1. The random effects were animal and error. The heritability estimate of ketosis was 0.04. Heritability estimates for MFP traits ranged from 0.04 for F1/F3 to 0.31 for F. Significant genetic correlation estimates were 0.32 for F1/F3 and F1/P1, and -0.30 for F. Genetic correlation estimates for F/P (-0.12) and F1 (0.15) were not significant. The genetic correlations indicated that higher average fat % over the lactation is associated with less ketosis. However, a high fat/protein ratio on test day 1 and a large decrease in fat % from test-day 1 to 3 were associated with more ketosis. Producers can continue to select for higher fat % across lactation without compromising metabolic health of lactating cows. Additionally, early lactation fat % may be useful as a genetic selection tool for resistance to ketosis.

Key Words: Ketosis, Milk Fat, Heritability

373 Short-interval unilateral frequent milking during early lactation of dairy cows results in acute and persistent increases in milk yield. A. C. Kissell*, E. H. Wall, and T. B. McFadden, *Lactation and Mammary Gland Biology Group, Department of Animal Science, University of Vermont*, *Burlington, VT*.

A short-interval unilateral frequent milking model (UFM) involving twice daily milking (2X) of the left udder half and four-times daily milking (4X) of the right udder half with 1.0 ± .3 h between regular and extra milkings was imposed during early lactation to test the hypothesis that remilking after a short interval would stimulate both acute and long-term increases in milk yield from the 4X half of the udder. Eight multiparous Holstein cows were assigned to UFM for d 1 to 21 of lactation, and were milked 2X thereafter. At the first milking post-calving, cows were quartermilked to verify similar milk production between the right and left halves of the udder. In order to quantify the milk yield response to UFM, cows were quartermilked on d 3, then weekly through 5 wk and once at 8 wk of lactation. Milk samples were collected during quartermilking and fat percent, protein percent, and SCC were measured by Vermont DHIA. During UFM, the 4X udder halves produced 1.3 ± .6 kg/d more milk than the 2X halves ($P < 0.05$). The difference in milk yield during UFM reached a maximum on d 21 (2.0 ± .6 kg/d; $P < 0.001$). After cessation of UFM, milk production from the 4X halves decreased slightly, but remained 1.6 ± .3 kg/d greater than the 2X halves through 55 DIM ($P < 0.05$). Milk SCC, fat percent, and protein percent were not affected by UFM ($P > 0.20$). We conclude that, although the interval was only 1 h, UFM increased milk production of the frequently-milked udder halves through 8 wk of lactation. Our results indicate that short-interval frequent milking during early lactation could increase milk production efficiency on small dairy farms.

Key Words: Frequent Milking, Half-udder, Milking Interval

374 Planting date may affect yield and nutrient composition of whole-plant small-grain forages. L. W. Manson*[1], M. A. Bal[1], M. Oba[1], and V. S. Baron[2], [1]*University of Alberta*, *Edmonton, AB, Canada*, [2]*Agriculture and Agri-Food Canada*, *Lacombe, AB, Canada*.

The objective of this study was to evaluate effect of planting date on nutrient composition of whole-plant small-grain forages harvested at the mid-dough stage. Two barley (AC Lacombe and Vivar), one oat (AC Murphy) and one triticale (Wapiti) varieties were planted at the Lacombe Research Station at 7 different dates, from May 12th to June 23rd 2005, and harvested at the same physiological stage of maturity (mid-dough stage). Dry matter (DM) yield and concentrations of crude protein (CP), neutral detergent fiber (NDF), in vitro fiber digestibility (IVFD), starch, and free glucose were determined. Earlier planting dates were associated with greater DM yield for barley, but not for triticale. The DM yield was positively related with the cumulative temperature ($r = 0.67$) and cumulative precipitation ($r = 0.44$) from heading to harvest. Concentrations of free glucose, CP and NDF at harvest were not affected by planting date for all varieties. However, CP concentration was related positively with the cumulative temperature from seeding to heading ($r = 0.33$) and negatively with that from heading to harvest ($r = -0.54$). Contrarily, free glucose concentration was associated negatively to cumulative temperature from planting to heading ($r = -0.43$), but positively from heading to harvest ($r = 0.54$). Planting date affected IVFD of oat ($P < 0.01$) and starch concentration of triticale ($P < 0.01$), but did not affect nutrient composition of barley varieties. In summary, planting date affected DM yield and nutrient composition of whole-plant small-grain forages. Altering planting date may allow for increased management options to optimize forage quality by changing growing environment characterized by cumulative

temperature and precipitation. Further studies are required to determine if planting date consistently affects forage quality and to evaluate its effects on productivity of ruminant animals.

Key Words: Planting Date, Forage Quality, Cereal Grain Forages

375 Using percent of mature body weight to manage dairy heifer growth. N. Keene* and D. Winston, *Virginia Polytechnic Institute and State University*, *Blacksburg*.

When raising dairy replacement heifers, producers face the challenge of determining whether differences in heifer growth are caused by genetics or management. Heifer growth is generally measured using body weights at breeding and calving and growth rates are then compared with breed standards. One problem with this approach is the large genetic variance for size that may be found within a breed. To address this issue, Van Amburgh and Meyer, 2005, proposed a system to express heifer growth as a function of mature body weight. Hoffman, 2006, applied this system, which reduces the growth variance attributed to genetics, and developed a universal heifer growth chart to use as a reference for all breeds. To practically apply this system, heifer weights were collected monthly at the Virginia Polytechnic Institute and State University Dairy Center. For the first 21 days post-calving, dam's body weights were electronically measured twice daily using scales in the parlor exit lanes. Mature body weight for each dam was estimated using Hoffman's equations, which convert the average weight to a 4th lactation equivalent. Data was then compared to breed standards to analyze strengths and areas of improvement in the heifer raising program overall and to identify outlier animals. This system could be utilized by any producer with the resources to regularly weigh heifers and lactating cows and record the data. A spreadsheet to aid dairy producers with calculating and graphing growth rates by the percent of mature body weight is being developed through this research.

Key Words: Mature Bodyweight, Growth

376 Effects of Black Seed Oil (Niagra Sativa) on the life cycle and reproductive behavior of C. elegans. C. G. Gerald*, M. W. Worku, P. M. Matterson, and Z. L. Liu, *North Carolina A&T State University*, *Greensboro*.

Nematode drug resistance is impacting the health of grazing livestock globally. Natural alternatives that may affect the parasite life cycle, impact pathogenesis or boost the host's immune response are being sought. Niagra Sativa L (Black seed) has been reported to have antihelminthic properties and is considered an immunomodulator. The free-living nematode Caenorhabditis elegans (C. elegans) is a well established biological model. This model can be used to evaluate immunomodulation and therapeutic drug action. Chemotaxis is an important behavior in enabling it to locate food sources such as E.coli. This study evaluates the effects of Black Seed Oil exposure on the life cycle and chemotactic behavior of C. elegans. A ring of bacteria (food) on NGM agar medium served as attractive signals to encourage C.elegans to move. Ten nematodes were placed in the center of the agar plate in 0, 0.25, 0.50 and 0.75 microliters of black seed oil. Over the three day life cycle the reproduction (number of worms), and chemotaxis (Number migrating to the ring of bacteria through the black seed oil) was recorded. Nematodes that had reached the food were picked individually to new seeded plates and allowed to recover and reproduce. As the concentration of Black seed oil increased the number of worms on a plate increased. Following the three day life cycle the total numbers of nematodes were higher following exposure to Black seed oil. A dose dependent effect of Niagra Sativa extract was observed on the numbers of nematodes migrating to E.coli. The chemotactic behavior was inhibited at 0.25ul of Black seed oil. Maximum numbers of worms migrating were observed at 0.75 ul. The molecular basis for these effects and the biochemical pathways involved will be evaluated.

Key Words: Black Seed Oil, C. Elegans

Tuesday, July 10, 2007
POSTER PRESENTATIONS

Animal Behavior & Well-Being - Livestock and Poultry

T1 Impact of elevated embryonic corticosterone on development, stress, and fear in broilers. S. M. Brougher and S. J. Snow*, *Delaware State University*, *Dover*.

Corticosterone (B), an adrenal steroid, is known to elevate in response to stressful poultry housing conditions (e.g. temperature extremes, density, negative behavioral interactions, and feed restriction). Negative consequences associated with elevated stress in poultry include reduced growth, increased fear, developmental instability, and compromised welfare overall. One concern is the deposition of B from stressed female broiler breeders into the yolks of their developing offspring. We hypothesized that an exogenous increase in embryonic B could disrupt development of the hypothalamic-pituitary-adrenal system, potentially manifesting through long term alterations in endpoints such as growth, fear, developmental stability, and plasma B. Broiler eggs were incubated at 37°C and 65% relative humidity, and randomly assigned to four treatment groups: control (C), sham control (S), low dose (L: 10 ng/mL) and high dose (H: 20 ng/mL) of B. Exogenous B was delivered via corn oil vehicle into the air cell of fertile eggs at d4 of incubation. Hatchlings were placed in 8 pens with 4 birds/treatment/pen (n=16 birds/pen) for 5 wks. Body weight was recorded weekly, and the following measurements were taken at 5 wks of age: (1) tonic immobility to determine the fear response; (2) the degree of asymmetry in tarsometatarsal length and width to evaluate developmental stability; and (3) plasma B by ELISA to determine overall levels of stress. Data were analyzed using a one-way ANOVA. Results showed no significant differences in growth rate degree of fluctuating asymmetry or the length of tonic immobility. Although there were no significant impacts of treatment on B levels, there was a trend (P = 0.08) for control and sham control females to have lower plasma B than males. In conclusion, the results of our study indicate that elevating B exposure during embryonic development does not seem to have any lasting residual effects on growth, fear response, or plasma B, therefore is unlikely to have any long term impact on broilers during the growout phase.

Key Words: Broiler, Stress, Fear

T2 The effects of rearing broiler chickens under different light intensities on fear responses. G. Fagerberg, J. A. Mench* and G. S. Archer, *University of California*, *Davis*.

It has been suggested that welfare of commercial broilers could be improved by increasing the ambient light intensity during growout. However, there is also concern that broilers reared under high light intensities may be more fearful and difficult to catch at market age. Straight-run Cobb broiler chickens (N=240) were housed in environmental chambers providing either 5 (LOW), 50 (MED) or 200 (HIGH) lux illumination during the 16-hour photophase. There were 4 chambers of chickens/treatment. Beginning at week 4 of age, four tests were used to evaluate fearfulness: 1) induction of tonic immobility; 2) response to novel object placed in the home pen; 3) response to novel human entering the home pen; 4) response to inverted handling after catching. Data were analyzed using the GLM. There was a trend (F=3.69; p=0.068) for a difference in the novel human test, with the latency for the last, but not the first, bird in the pen to approach the novel human being greater in HIGH (120.07±41.63) than in either MED (17.40±3.40) or LOW (54.40±21.37), with the difference between HIGH and MED being statistically significant. However, there were no significant treatment differences for the three other tests, with the number of attempts to induce tonic immobility and tonic immobility duration; number of vocalizations and number, intensity and duration of wingflaps during inverted handling; and latencies to approach the novel object; being similar among the treatment groups. These results suggest that rearing broilers at higher light intensities has little effect on fearfulness or on responses to catching and handling at market age.

Key Words: Broiler, Fear, Lighting

T3 Effect of feeding space availability on aggressive behavior of Holstein heifers on high-concentrate diets. L. A. González*[1], A. Ferret[1], X. Manteca[1], J. L. Ruíz-de-la-Torre[1], S. Calsamiglia[1], M. Devant[2], and A. Bach[2], [1]*Universitat Autonòma de Barcelona*, *Bellaterra, Spain*, [2]*Unitat de Remugants-IRTA*, *Barcelona, Spain*.

Seventy two Holstein heifers (BW 138.0 ± 2.4 kg) were randomly assigned to a 3 × 3 complete block design, similar BW between treatment pens of each weight block, to study the effect of the feeding space availability on social behavior. Treatments consisted of 1 (T1), 2 (T2) or 4 (T4) concentrate feeding places/pen separated by vertical feed barriers (8 heifers/pen). The linear space available in the 2 straw feeders per pen was 0.35 m/animal in T1 and T2, and 0.25 m/animal in T4 pens with no feed barriers. Concentrate (3 Mcal of ME/kg, 16.4% CP, 20.3% NDF, DM basis) and straw were fed daily at 0830 ad libitum and in different feeders. Video recordings were analyzed by continuous sampling for the number and location of displacements over 2 d in wk 8, 16 and 28 of the fattening period. Data were analyzed as

a Poisson regression model considering the fixed effects of treatment, block and week (repeated measure), and pen as a random effect. The number of displacements (ND) per pen and day in the concentrate feeders was greatest in T1 (67.0 ± 2.6), intermediate in T2 (33.7 ± 1.8) and lowest in T4 (19.3 ± 1.4; P < 0.05). The ND in the straw containers was greater in T4 (54.8 ± 3.5) compared to T1 (36.2 ± 3.0; P < 0.05) and T2 (38.3 ± 3.2; P < 0.10). The ND in the water bowls (2 per pen) was greater in T2 (22.2 ± 1.4) compared to T1 (12.8 ± 1.1) but no different from T4 (17.2 ± 1.3; P < 0.05). These led to a treatment effect (P < 0.05) for the total ND per pen and day being greatest in T1 (122.4 ± 6.2), intermediate in T2 (100.6 ± 5.3) and lowest in T4 (81.9 ± 4.5). Although the ND from the concentrate feeders were highest with the lowest number of feeding places per pen (T1) and the ND from straw feeders were highest with the lowest linear space per animal (T4), it is possible that T2 groups re-directed part of the aggressive interactions, needed to establish or maintain the priority of access to resources, towards the water bowls.

Key Words: Heifers, Feeding Space, Aggressive Interactions

T4 Relationship between calves' social rank and performance after arrival at the feedlot with different feeding place availability. L. A. González*[1], A. Ferret[1], X. Manteca[1], J. L. Ruíz-de-la-Torre[1], S. Calsamiglia[1], M. Devant[2], and A. Bach[2], [1]*Universitat Autonòma de Barcelona*, *Bellaterra, Spain*, [2]*Unitat de Remugants-IRTA*, *Barcelona, Spain*.

Seventy two Holstein female calves (BW = 110.4 ± 2.5 kg) were randomly assigned to a 3 × 3 complete block design to study the effect of social dominance on ADG during wk 1 and 3 after arrival at the feedlot with different levels of social pressure at the concentrate feeders. Calves were blocked by BW and treatments consisted of 1 (T1), 2 (T2) or 4 (T4) feeding places/pen (8 calves/pen). Pelleted concentrate and straw were fed at 0830 ad libitum and in different feeders. Displacements between calves from the concentrate and straw feeders, and water bowls, were registered over 3 d at wk 1 and 3 after arrival at the feedlot, and DMI and ADG were determined weekly. Angular dominance value (ADV) was calculated as the arcsine square root of the average proportion of displacements won by an animal against each dyad member in the pen. Data were analyzed with a linear mixed regression model considering the fixed effects of treatment and block, and the linear and quadratic effect of ADV. Week as a repeated measure, animal within pen and pen were random effects. DMI and ADG increased linearly (P < 0.05) during wk 1 as the number of feeding places per pen increased. DMI increased quadratically at wk 3 (P = 0.02) with the lowest DMI for T1 calves. A significant ADV × week × treatment interaction was observed (P < 0.001). In T1 calves, increasing ADV resulted in a linear decrease in ADG at wk 1 (β = -0.55; P = 0.03) and a quadratic increase at wk 3 (β = 5.49; β^2= - 3.45; P < 0.01) showing a high positive slope. In T2 calves, increasing ADV resulted in a linear decrease of ADG at wk 1 (β = -0.50; P = 0.04) but a linear increase at wk 3 (β = 0.56; P = 0.02). No significant effect of social rank on ADG was observed in T4 calves. Increasing social pressure at the concentrate feeders reduced DMI and ADG because the repercussions of dominance values were greater.

Key Words: Calves, Feeding Place, Dominance

T5 Behavior and welfare of laying hens in single-tier aviaries with and without outdoor area. T. Tanaka*[1], T. Shinmura[1], T. Suzuki[1], S. Hirahara[2], Y. Eguchi[1], and K. Uetake[1], [1]*Azabu University*, *Sagamihara, Japan*, [2]*Kanagawa Prefectual Livestock Industry Technical Center*, *Ebina, Japan*.

The objective of the present study was to examine the behavioral frequency and pattern of laying hens in single-tier aviaries with and without outdoor areas, and to compare the welfare level between the two systems in association with other important measurements. In total, 144 interbred cross layers (WL × RIR) were used. At the age of 16 weeks, the hens were randomly divided into two groups consisting of four single-tier aviaries (SA) with 18 hens per pen and four free-range systems (FR) with 18 hens per pen. The free-range system was a single-tier aviary with an outdoor area (1.1 m2/hen) with planted clover. Behavioral observations were conducted before (0600-0800), during (1000-1200 and 1300-1500) and after (1700-1900) the pasturage. Eating, grazing, drinking, preening, aggressive pecking, feather pecking, litter pecking, object pecking and mate pecking were defined as pecking behavior. Feather condition, foot condition, TI test, H/L ratio were also measured. 18% of FR hens spent their time grazing. Conversely, eating (P <0.01), preening (P <0.01), litter pecking (P <0.05), object pecking (P <0.05), aggressive pecking (P <0.01) and feather pecking (P <0.01) were more frequently performed in SA than in FR. The total frequency of pecking behavior in SA was similar to that in FR (61.7±2.0% and 64.0±0.8%, respectively). While pre-laying behavior decreased from 0600-0800 to 1700-1900, pecking behavior increased. Aggressive pecking and feather pecking were observed frequently at 1000-1200 and 1300-1500 in SA, and at 1700-1900 in FR (system × observation time, both P <0.01). Feather condition on the part of vent as worse in SA than in FR (P <0.05). Claw lengths of the center front and rear were shorter in FR than in SA (P <0.001 and P =0.06, respectively). TI duration was shorter in FR than in SA (P <0.05). In conclusion, it was suggested that total frequency of pecking behavior was similar between these systems either with or without outdoor area. The risk for cannibalism is lower, and hens' fear reaction and claw length is also improved by the existence of an outdoor grazing area. It was indicated that welfare level is higher in FR compared with SA.

Key Words: Non-cage System, Welfare

T6 Relation between social order and use of resources in small and large furnished cages for laying hens. T. Shimmura*[1], T. Azuma[1], S. Hirahara[2], Y. Eguchi[1], K. Uetake[1], and T. Tanaka[1], [1]*Azabu University*, *Sagamihara, Japan*, [2]*Kanagawa Prefectual Livestock Industry Technical Center*, *Ebina, Japan*.

The objective of the present study was to determine the relation between social rank and use of resources such as the nest box and dust bath by using a popular smaller furnished cage and an approved large one. In total, 92 interbred cross layers (WL × RIR) were used. At the age of 16 weeks, the hens were randomly divided into two groups consisting of four small furnished cages (SF, 90 cm wide × 46.5 cm deep) with five birds per cage, and four large furnished cages (LF, 240 cm wide × 62.5 cm deep) with 18 birds per cage. The dominance hierarchy was determined; by which high, medium and low ranked hens in each cage were identified. The behavior, use of resources and physical condition of these hens were measured. Data were analyzed by using repeated measure ANOVA. The high ranked hens spent more

time in the dust bath than the medium and low ranked hens in LF (both $P < 0.05$), while no significant difference was found between them in SF. The high ranked hens performed dustbathing and litter scratching more frequently than the medium and low ranked hens in LF (both $P < 0.01$), while no significant difference was found between them in SF. The amount of time spent in the nest box was similar between each rank in SF and LF. However, the amount of time spent by LF low ranked hens performing pre-laying (sitting in nest) was lower compared with LF medium and high ranked hens (Social order × Cage design, $P = 0.08$). Concerning hens in the nest box, more than 90% of SF hens, LF high and medium ranked hens performed pre-laying. Conversely, LF low ranked hens spent thier time escaping (33.1%), pre-laying (27.7%), standing-resting (25.7%) and moving (13.5%) in the nest. In conclusion, under the condition that aggressive interaction occurred frequently, higher ranked hens would have priority using the dust bath. In contrast, low ranked hens would spend more time in the nest box for 'refuge' rather than for laying. It was also suggested that allowances for the size and/or arrangement methods of each resource be made in furnished cages, especially large ones.

Key Words: Furnished Cage, Social Order, Resource

T7 Effects of dust bath and nest box arrangement on behavior of high-, medium- and low-ranked hens in furnished cages. T. Shinmura*, Y. Eguchi, K. Uetake, and T. Tanaka, *Azabu University*, *Sagamihara, Japan*.

In our previous studies, it was confirmed that aggressive interaction occurred frequently in the dust baths in furnished cages. In later research, we demonstrated that dominant hens had priority in using the dust bath. Also, it was reported that this tendency was more pronounced in the larger furnished cages. Therefore, we contrived a new medium furnished cage with separated resources. The objective of the present study was to evaluate the effects of dust bath and nest box arrangement on the behavior of hens from each rank in the new furnished cages compared with small and medium furnished cages with concentrated resources. In total, 150 White Leghorn layers were used. At the age of 17 weeks, the hens were randomly divided into three groups consisting of small furnished cages (SF, 90 cm wide × 46.5 cm deep; six cages; five birds per cage) and two types of medium furnished cages (180 cm wide × 46.5 cm deep; six cages; 10 birds per cage) with separated resources on both sides (MFS) and concentrated resources on one side of the cage (MFC). The dominance hierarchy was determined, by which high, medium and low ranked hens in each cage were identified. The behavior, use of resources and physical condition of these hens were measured. Data were analyzed by using repeated measure ANOVA. Significant interaction between social order and cage design were found in reference to the amount of time spent in the dust bath and on performing dustbathing (both $P < 0.001$), and these proportions of time were higher among the SF high ranked hens, MFC high and medium ranked hens than in the low ranked hens. Conversely, the MFS low ranked hens used the dust bath more than the SF and MFC low ranked hens. In MFS, hens from each rank used the dust bath equally, though the high ranked hens used this resource less than the SF and MFC high ranked hens. In conclusion, higher ranked hens had priority over use of the dust bath in SF and MFC. In contrast, it was confirmed that each rank of hens used the resources equally in MFS. It was suggested that separation of the resources in furnished cages is an effective measure in improving hen welfare.

Key Words: Furnished Cage, Social Order

T8 Effect of stocking density on the short-term behavior of dairy cows. C. T. Hill[1,2], P. D. Krawczel*[1,2], H. M. Dann[1], C. S. Ballard[1], R. C. Hovey[2], and R. J. Grant[1], [1]*W.H. Miner Agricultural Research Institute*, *Chazy, NY*, [2]*The University of Vermont*, *Burlington*.

The objective of this study was to determine the effect of stocking density on the short-term behavior of dairy cows. Holstein cows (n = 136) were housed in a freestall barn, fed a total mixed ration daily and milked 3× daily. Cows were assigned to 4 pens with stocking densities (100, 113, 131, and 142%) imposed in a 4 × 4 Latin square for 7 d. Each cow was provided a stall and headlock at 100% stocking density while the greater stocking densities were simulated by denying access to freestalls and headlocks. The mean percentage of cows feeding, lying, and standing was determined using 10-min scan samples from digitally-recorded video data collected during the final 2 d at each stocking density. Milk composition was determined for all cows during a 24-h period at each stocking density. Although the mean percentage of cows feeding during a 24 h period (20.5%) did not differ among treatments ($P = 1.0$), increased stocking density reduced the percentage of cows feeding following their return from milking (67.2 at 100% stocking density versus 54.8 at 142%; $P = 0.009$). The percentage of cows lying decreased from 50.8 at 100% stocking density to 47.4 at 142% ($P = 0.007$). The percentage of cows standing in an alley increased from 8.8 at 113% stocking density to 12.6 at 142% ($P < 0.001$), while the percentage standing in stalls decreased from 10.8 at 100% stocking density to 9.2 at 142% ($P = 0.02$). Milk fat was reduced from 3.8% at 100% stocking density to 3.6% at 142% ($P = 0.03$). The decreased percentage of cows lying, increased percentage of cows standing, and reduced milk fat percentage suggest that increased stocking densities were detrimental. However, similar behavioral responses at 100% and 113% stocking density indicate cows can be housed at 113% before observable changes in behavior occur.

Key Words: Stocking Density, Behavior

T9 Survey of calf and heifer husbandry practices on dairies in the mid-western and eastern U.S. W. K. Fulwider*, T. Grandin, D. J. Garrick, T. E. Engle, W. D. Lamm, N. L. Dalsted, and B. E. Rollin, *Colorado State University*, *Fort Collins*.

The objective was to determine how heifers are being managed on dairies up until the time of calving. Dairies were visited during the fall and winter in WI, MN, IN, IA, and NY. Data were collected on 113 dairies regarding colostrum feeding, dehorning, tail docking, custom calf-raising, and the level of satisfaction with calf-raising by producers. Three feedings of colostrum were received by calves on 24% of dairies, 2 feedings on 62% of farms, 1 feeding on 30% of farms, and no colostrum fed on 4% of farms. Many farms (62%) administered 3.8 L at first feeding. Calves were dehorned at various ages by various methods. Between 2 and 4 wk was the most common time to dehorn, with 25% of calves processed. By 20 wk, 83% of calves were dehorned. The majority of calves were dehorned by burning (66%). The remainder was dehorned by gouging (9%), paste (10%), saw (4%), and unknown by calf owner (12%). Anesthetic use was reported by 12% of dairy owners, and analgesia use by 2%. Tail-docking was reported on 86% of dairies. None of the dairies trimmed switches. The most common reported docking period was pre-, or post-calving (27.68%). The second most commonly reported period was day 1 of life (13%). Banding was the most common method (75%) followed by pruning (25%). Three dairies pruned pre-calving, one at 2-mo, and

two at day 1. Cleanliness was the most common reason to dock (73%), parlor milking (17%), and udder health (1%). Calves were raised by the owner on 50% of dairies, while 44% custom raise calves for at least a portion of the growing period. Only one producer sold calves and purchased heifers back pre-calving. Only 29% of dairies had heifers' custom raised during a portion of the milk feeding period. Satisfaction reported by producers regarding calf-raising was highly satisfied (51%), satisfied (31%), okay (8%), less than satisfied (6%), and need to change (3%).

Key Words: Calf, Dehorn, Tail-dock

Animal Health - Livestock and Poultry: Poultry/Swine/Goat/Sheep

T10 Colicin E1 prevents *Escherichia coli* F18 caused post-weaning diarrhea in pigs. S. A. Cutler*, N. Cornick, S. M. Lonergan, and C. H. Stahl, *Iowa State University*, *Ames*.

The use of dietary prophylactic antibiotics to prevent post-weaning diarrhea (PWD) in pigs is common practice in the U.S. swine industry. Despite this preventive measure, PWD still causes substantial losses to the swine industry due to both mortality and reduced growth performance in surviving pigs. With world-wide concern over the use of antibiotics in animal agriculture, alternatives to conventional antibiotics are desperately needed. The bacteriocin, Colicin E1 (ColE1), is effective against the *E. coli* strains responsible for PWD in vitro. In this study, we examined the efficacy of dietary inclusion of ColE1 in preventing experimentally induced PWD. Weaned pigs (n=16, 18d of age), all genetically susceptible to *E. coli* F18, were allocated into 2 groups, based on body weight, and fed corn-soy diets containing either 0 or 16.5mg ColE1/kg diet. After 2d on the treatment diets, all animals were orally inoculated with 1×10^9 CFU of 2 *E. coli* F18 strains isolated from pigs with PWD. Body weight (BW) and fecal scores were recorded daily, and *E. coli*. coli from rectal swabs were enumerated daily. All animals were euthanized 4d post-inoculation and sections of the ileum were collected for histology, *E. coli* enumeration, and gene expression. The inclusion of ColE1 decreased ($P\leq0.05$) the incidence and severity of PWD as demonstrated by the reduction ($P\leq 0.05$) in incidence of diarrhea (none in ColE1 fed pigs vs. 6 out of 8 in the controls). Inclusion of ColE1 improved ($P\leq0.05$) BW gain for ColE1 fed pigs compared to the controls (940g/d vs. 380g/d, respectively), and it is interesting to note that 3 control pigs, but none of the pigs fed ColE1, lost weight during this trial. Additionally, dietary addition of ColE1 reduced the gene expression of the cytokines *IL1*β ($P\leq0.02$), *iNOS* ($P\leq0.08$), and *TNF*β, ($P\leq0.06$) in ileal tissue compared to the control animals, suggesting a decreased inflammatory response in these pigs. Dietary inclusion of ColE1 appears to be an effective alternative to conventional antibiotics in the diet of swine for the prevention of PWD.

Key Words: Pigs, Colicin, PWD

T11 Evaluation of photonic imaging in the gastrointestinal tract of swine following oral inoculation with lux-modified *Salmonella typhimurium*. K. Moulton*[1], P. Ryan[1], R. Youngblood[1], M. McGee[1], S. Laird[1], A. Harris[1], D. Moore[1], I. Kim[1], D. Lay[2], and S. Willard[1], [1]*Mississippi State University*, *Mississippi State*, [2]*USDA-ARS*, *West Lafayette, IN*.

The objective was to evaluate photonic emitting bacteria through different segments of the gastrointestinal tract of swine. Pigs (~ 80 kg) were inoculated orally with 3.1 or 4.1×10^{10} CFU of *Salmonella typhimurium* transformed with plasmid pAK1-lux (S. typh-lux) for a 6 (n=6) or 12 (n=6) h incubation in vivo. Pigs were euthanized at 6 or 12 h. Intestinal regions (duodenum, jejunum, ileum, large intestine) were divided into 5 replicates of 4 segments (5 cm) each for imaging. For each replicate, two segments of each region were intact, while 2 segments were opened to expose the digesta. Sub-samples of digesta were analyzed for CFU, and images were analyzed for relative light units/sec (RLU/sec). At 6 h, a higher ($P<0.05$) concentration of emitting bacteria and consequently higher ($P<0.05$) detection of photonic emissions was observed in small intestine than large intestine. The correlations (6 h) of photonic emissions in opened segments to bacterial concentrations were r = 0.73, 0.62, 0.56, and 0.52 ($P<0.05$) in duodenum, jejunum, ileum, and large intestine, respectively. Photonic emissions were higher ($P<0.05$) in jejunum, ileum, and large intestine than in duodenum of intact segments post 6 h incubation. At 12 h, a higher ($P<0.05$) concentration of emitting bacteria in jejunum and ileum of open segments was observed than in duodenum and large intestine of open segments. Photonic emissions were higher in ileum than duodenum, jejunum and large intestine of open segments ($P<0.05$). The correlations (12 h) of photonic emissions in opened segments to bacterial CFU's were r = 0.71 and 0.62 for jejunum and ileum, respectively ($P<0.05$). At 12 h, a higher ($P<0.05$) concentration of emitting bacteria in jejunum and ileum of intact segments was observed than in duodenum and large intestine. These data indicate CFU were higher in small intestine after 6 and 12 h incubations, and a minimum of 2.0×10^5 CFU yields detection through these tissues (~ 1.0 to 21.0 RLU/sec). This study demonstrates feasibility of using biophotonics in research models for evaluating pathogenicity of *Salmonella* in swine.

Key Words: Swine, Biophotonics, *Salmonella*

T12 Development and optimization of species-specific PCR for rapid detection of Dermatophilus congolensis. S. Valipe, M. Amalaradjou, J. Nadeau*, A. Thirunavukkarasu, and K. Venkitanarayan, *University of Connecticut*, *Storrs*.

Dermatophilosis is a contagious and zoonotic disease in farm animals caused by *Dermatophilus congolensis*. Dermatophilosis is responsible for significant economic losses due to reduced milk production in cattle, wool losses in sheep, lameness and loss of days in showing horses. Accurate and rapid diagnosis of dermatophilosis is essential for specific therapeutic and preventive measures against the disease. The currently available methods for identification of *D. congolensis* are laborious and time-consuming; thus there is a need for a rapid method for detecting the bacterium. Polymerase chain reaction (PCR) is a highly specific and sensitive method used for the rapid detection of microorganisms. In this study, we developed a species-specific PCR to detect *D. congolensis* based on a 1029-bp internal, conserved region of its alkaline ceramidase gene. Chromosomal DNA from 8 strains of *D.congolensis* and 33 strains of negative control bacteria, including other common equine pathogens, environmental bacteria and

phylogenetically related bacteria were used as templates in the PCR. Amplification was carried out in 25-µL volumes of reaction mixture containing 2.5 mM $MgCl_2$, 50 mM of each nucleotide, 0.5 µM of each primer, 0.125 U of Taq polymerase and approximately 50 ng of template DNA from each bacterium. Initially the reaction mixture was heated to 94°C for 5 min and subjected to 30 cycles of PCR. Each PCR cycle consisted of denaturation at 92°C for 30 sec, annealing at 56°C for 45 sec and extension at 72°C for 45 sec. At the end of 30 cycles, a final extension at 72°C for 10 min was provided. The presence and the size of the PCR products were determined by agar gel electrophoresis. PCR amplified a 1029-bp DNA fragment from all the 8 strains of *D. congolensis*, but not from the negative control bacteria. Results indicate that the PCR developed in this study could potentially used for the rapid diagnosis of dermatophilosis, but it needs to be validated in farm animals.

Key Words: Dermatophilosis, PCR, Detection

T13 Necrotic Enteritis control in broilers chickens fed the feed additives RepaXol, AciXol, or Virginiamycin. G. Mathis*[1] and N. Scicutella[2], [1]*Southern Poultry Research, Inc.*, *Athens, GA*, [2]*SODA Feed Ingredients*, *Monaco*.

The objective was to compare the level of Necrotic Enteritis in Clostridium perfringens challenged broilers fed the feed additives RepaXol, a blend of double coated essential oils, AciXol an encapsulated blend of organic and inorganic acids along with the essential oils (as in RepaXol) or Virginiamycin, an antibiotic. A randomized block design with 6 replications of 10 birds per cage was used. The treatments were nonmedicated, non-challenged (NMNC), nonmedicated, challenged (NMC), RepaXol 100 ppm, AciXol 500 ppm, and Virginiamycin (VIR) 20 ppm. Birds were challenged on Day 14 with E. acervulina and E. maxima and on Days 19, 20, and 21 with Clostridium perfringens. The performance parameters measured were feed conversion and weight gain. Level of Necrotic Enteritis (NE) was determined by NE mortality and NE lesion scores. There was a significant improvement in feed conversions and weight gains for RepaXol, AciXol and VIR. The percent NE mortality for NMC was 33%. There was no significant difference in percent NE mortality between RepaXol (23%), AciXol (22%) and VIR (12%). All treatments had significantly lower NE lesion scores compared to NMC. This study demonstrated the benefits of adding RepaXol 100 ppm, AciXol 500 ppm, or Virginiamycin 20 ppm into the feeds of broiler chickens exposed to Clostridium perfringens.

Key Words: RepaXol, AciXol, Virginiamycin

T14 Molecular ecology effects of essential oil blends on identified broiler cecal digestive bacteria. Y. Leontieva*[1], A. Syvyk[1], A. Nalian[1], M. Hume[2], E. Oviedo-Rondon[3], S. Clemente-Hernández[4], and A. Martynova-Van Kley[1], [1]*Stephen F. Austin State University*, *Nacogdoches, TX*, [2]*USDA, ARS, SPARC, Food and Feed Safety Research Unit*, *College Station, TX*, [3]*North Carolina State University*, *Raleigh*, [4]*Universidad Autónoma de Chihuahua*, *Chihuahua, México*.

Essential oil blends are generating increased attention as alternatives to antibiotic treatments in broiler production. The aim of this study was to identify the intestinal microbial species most affected by different blends of essential oil supplements, Crina Poultry (CP) and Crina Alternate (CA). Cecal contents from three broiler treatment groups were analyzed: 1) birds on basal diet (BD); 2) birds on basal diet supplemented with (CP); 3) birds on basal diet supplemented with (CA). Digestive bacteria banding profiles were examined by the PCR-based denaturing gradient gel electrophoresis (DGGE). In order to carry out a conclusive phylogenetic identification of the species and to overcome the limitation of the sequencing of short fragment PCR products required for DGGE analysis, we generated clone libraries from longer ~520bp 16S rDNA PCR products. To select unique clones representing predominant and minor members of the bacterial community, PCR of short fragments (~250bp) was carried out using clone DNA as a template. The short PCR products were then screened using DGGE against the original field samples and unique short fragments and their corresponding clones were identified. Subsequently, clones containing long fragment and matching to DGGE bands affected by the presence of essential oil supplements in the broiler diet were selected for sequencing. This methodology provides a simple way of screening clone libraries to obtain longer and more useful sequencing data for phylogenetic identification of members of broiler digestive microbial population.

Key Words: Essential Oil Blends, DGGE, Microbial Community

T15 Electrospray-ionization mass spectrometric analysis of lipid restructuring in the chick liver: Effect of maternal dietary conjugated linoleic acid. G. Cherian*, *Oregon State University*, *Corvallis*.

The effects of egg yolk conjugated linoleic acid (CLA) on hatched chick liver phospholipid molecular species were determined by electrospray-ionization mass spectrometry. Eggs with no, low or high levels of CLA were produced by feeding hens a corn-soybean meal basal diet containing 3% (wt/wt) corn oil (Control), 2.5% corn oil +0.5 % CLA oil (CLA1) or 2% corn oil + 1.0% CLA oil (CLA2).Yolk total CLA was 0.0, 1.0 and 2.6% for Control, CLA1 and CLA2, respectively ($P<0.05$). Chicks hatched from CLA1 and CLA2 eggs incorporated higher levels of cis9, trans11 CLA in the liver than did chicks from Control ($P<0.05$). A 21 and 38% reduction in the abundance of total phosphatidylethanolamine (PE) species was observed in the liver of CLA1 and CLA2 chicks respectively, as compared to Control chicks ($P<0.05$). The largest observed change in PE was a 32% decrease in 18:0/20:4 ($P<0.05$). Total phosphatidylcholine (PC) in the liver of CLA1 and CLA2 chicks was reduced by 16 and 28% respectively, when compared to Control chicks ($P<0.05$). The major changes in PC were a 40% reduction in the abundance of 18:0/20:4 ions in CLA1 and CLA2 ($P<0.05$). Significantly reduced 16:0/18:1 and 16:0/20:4 ions were also observed in the PC of CLA1 and CLA2 than Control ($P<0.05$). Significant increases in the abundance of 16:0 and 18:0 in the lyso PC and lyso PE were observed in CLA1 and CLA2. These results suggest that maternal or egg yolk CLA results in a remodeling of phospholipid molecular species in the chick liver. Though very little is known about the physiological or pathological role of specific molecular species during embryogenesis, it is likely that this remodeling will impact a range of cellular functions affecting embryo health and hatchability.

Key Words: Electrospray Ionization Mass Spectrometry, Conjugated Linoleic acid, Phospholipid Species

T16 Maternal dietary n-3 fatty acids alter proinflammatory eicosanoid production in broiler birds. J. Bautista-Ortega*, D. E. Goeger, and G. Cherian, *Oregon State University*, *Corvallis*.

The objective of this research was to evaluate the contribution of a maternal diet enriched with omega-3 fatty acids on eicosanoid metabolism and antioxidant enzyme activities in broiler birds. Fertile eggs with high or low n-3 fatty acids were obtained by feeding breeder hens diets containing 3.0% sunflower oil (Low n-3), 1.5% sunflower oil and 1.5% fish oil (Medium n-3), or 3.0% fish oil (High n-3). These oils were chosen due to their high content of n-6 or n-3 fatty acids. The hatched chicks were fed a commercial diet devoid of long chain n-3 fatty acids. On the day of hatching, generation of proinflammatory eicosanoid (prostaglandin E2) was highest in the heart tissue of Low n-3 chicks ($P<0.05$). Heart tissue of chicks hatched to hens fed High and Medium n-3 diets synthesized higher thromboxane B3 than those of Low n-3 chicks ($P<0.05$). At day 42 of growth, prostaglandin E2 and thromboxane B2 (proaggregatory) generation was highest in the cardiac ventricles of chicks hatched to hens fed Low n-3 diets ($P<0.05$). Weight of the ventricle as a percentage of heart weight was higher in Low n-3 birds as compared to High n-3 birds. Chicks hatched to hens fed High n-3 diets had lower catalase activity in their heart tissue than did Low n-3 chicks ($P<0.05$). Maternal diet did not alter the activities of glutathione peroxidase, total glutathione, glutathione reductase or superoxide dismutase in the heart tissue. On day 42, the total lipid content of plasma was lowest in High n-3 birds ($P<0.05$). These results indicate that maternal dietary n-3 fatty acids alter proinflammatory eicosanoid production in chicks, which could lead to fewer inflammatory-related disorders in broiler chickens.

Key Words: n-3 Fatty Acid, Eicosanoid

T17 Immunomodulatory potential of feed borne *Fusarium* mycotoxins in broiler breeders Iinfected with coccidia. G. N. Girgis*, T. K. Smith, S. Sharif, J. R. Barta, and H. J. Boermans, *University of Guelph*, *Ontario, Canada,*.

The potential for *Fusarium* mycotoxins to modulate immunity was studied in broiler breeders raised to 10 weeks of age using a coccidia infection model. Day-old breeders were randomly divided into 3 groups, 40 birds each. Diets included: (1) control (2) contaminated grains (3) contaminated grains + a polymeric glucomannan mycotoxin adsorbent (GMA, Mycosorb®, Alltech Inc., Nicholasville, KY). Contaminated diets contained up to 3.8 ppm deoxynivalenol (DON), 0.3 ppm 15-acetyl DON and 0.2 ppm zearalenone. Half of the birds in each group were orally inoculated at 8 weeks of age with a cocktail comprising *Eimeria acervulina*, *E. maxima* and *E. tenella*. Serum, whole blood and caecal tonsils were collected from all birds prior to inoculation, at the end of challenge period (7 days post inoculation, PI), and at the end of recovery period (14 days PI). Serum IgA levels in infected birds fed contaminated diet were found to be significantly reduced at the end of recovery period. Flow cytometry of isolated blood lymphocytes revealed that CD8+ cell populations in the same birds were significantly lower than controls. Using real-time PCR, interferon-γ gene expression in caecal tonsils at the end of challenge period was significantly higher in birds fed contaminated and GMA-containing diets compared to birds fed the control diet. It was concluded that *Fusarium* mycotoxin-induced immunomodulation involves intestinal immunity and interferes with recovery from *Eimeria* infection.

Key Words: *Fusarium*, immunity, coccidia

T18 Broiler performance on a Maxiban® anticoccidial program with exposure to a mixed *Eimeria* population. A. Barri[1], C. L. Novak[1], H. D. Danforth[2], S. J. Steinlage[3], and A. P. McElroy*[1], [1]*Virginia Polytechnic Institute and State University*, *Blacksburg*, [2]*USDA/ARS*, *Beltsville, MD*, [3]*Elanco Animal Health*, *Greenfield, IN*.

This study compared inclusion of Maxiban® in the diet to *Eimeria* vaccination for broiler performance during exposure to a mixed environmental coccidia exposure. The 37-d day trial consisted of three treatment groups (n=540/trt): negative control (CON; non-medicated diet/no vaccination), Maxiban diet (MAX; 72g starter, 81g grower, 0g finisher) and a group vaccinated (VAC) with a commercial live *Eimeria* vaccine. Evaluation included body weight (BW), BW uniformity and gain (BWG), feed intake, mortality, adjusted feed conversion (FC), intestinal lesion scores, and tensile strength. Prior to this trial, birds challenged with a mixed *Eimeria* population were placed in pens to seed the litter. MAX or VAC resulted in heavier ($P<0.05$) BW as compared to CON for the starter period (d0 to18), and MAX broilers were heavier than CON or VAC on d37. On d18 and d32 MAX resulted in more uniform BW as compared to CON, while VAC birds were not different from CON or MAX. MAX resulted in increased BWG overall as compared to CON, and MAX or VAC resulted in increased BWG for d0-18 in comparison to CON. No differences in BWG were observed for the grower (d19 to 32) or finisher (d33 to 37) periods. During all periods, MAX had better FC as compared to CON. For d0 to 37, MAX (1.64) resulted in the most efficient FC as compared to VAC (1.68), as an intermediate, or CON (1.74). FC of VAC birds was better than CON for d0 to 18, while it was intermediate to MAX and CON for d33 to37. MAX had lower mortality (%) in the starter (2.0) and grower (1.2) periods as compared to CON (20.6 and 17.5). For these periods, mortality of VAC birds (4.4 and 5.3) was not different from either CON or MAX. For d0 to 37, MAX (4.0) and VAC (9.9) had lower mortality than that of CON (33.1). MAX had less severe *E. maxima* and *E. tenella* as compared to CON. Similarly, VAC broilers had less severe lesions for *E. tenella*. No differences were observed for *E. acervulina* lesions or tensile strength. These data suggest that MAX, and to a lesser extent VAC, improved performance of broilers exposed to a mixed environmental *Eimeria* population as compared to non-medicated, non-vaccinated broilers.

Key Words: *Eimeria*, Broilers, Vaccination

T19 Rapid detection of avian reoviruses in cloacal swabs using real-time RT-PCR. K. Guo*, T. Dormitorio, and J. Giambrone, *Auburn University*, *Auburn, AL*.

Avian reoviruses (ARV) can cause a variety of diseases, such as tenosynovitis, malabsorption syndrome, chronic respiratory disease, and immunosuppression in young commercial poultry. Therefore, early detection is critical for proper vaccination and prevention of ARV infections. In the current study, we applied the previously reported Sigma NS primer-probe set, which was designed by our lab, for the

detection of the ARVs in cloacal swab samples, from infected chickens with the Roche LightCycler. Preliminary studies indicated that this method identified 60% of the swab samples as positive at 3-day post-infection (PI) with an ARV strain 2408. At 7-day post-infection, 40% were detected positive with this method. The whole process of sample collection, RNA extraction, and real-time RT-PCR was completed within 4hrs, compared with virus isolation in cell culture or embryos, which takes up to 3days. This technique can be used for the rapid detection of ARVs in the diagnostic laboratory.

Key Words: Avian Reovirus, Real-time RT-PCR, Cloacal Swab Sample

T20 Development of a polymerase chain reaction assay for rapid identification of the causative agent of ulcerative enteritis. L. Bano*[1], K. S. Macklin[2], S. W. Martin[2], R. S. Miller[2], R. A. Norton[2], O. A. Oyarzabal[2], and S. F. Bilgili[2], [1]*Istituto Zooprofilattico Sperimentale delle Venezie*, *Treviso, Italy*, [2]*Auburn University*, *Auburn, AL*.

Clostridium colinum is the causative agent of ulcerative enteritis (UE), an important disease of bobwhite quail (Coluinus virginianus). UE has been reported also in chickens between 4 and 25 weeks of age, with a mortality rate of up to 50%. The aim of the present study was to develop a polymerase chain reaction (PCR) assay specific for C. colinum and to determine the detection limit of this assay in artificially inoculated fecal material. The 16S rDNA sequences of C. colinum, C. disporicum and C. piliforme were aligned and two primers were developed that would react only with C. colinum. The specificity of these primers were tested with American Type Culture Collection (ATCC) strains of C. colinum, C. perfringens, C. sporogenes, C. septicum and C. sordelii. The expected amplified product (935 bp) was observed only with DNA from C. colinum. Results from performing PCR assays on fecal samples from quails spiked with different concentrations of C. colinum showed that the detection limit of the assay was 1.6 x 104 CFU of C. colinum per g of fecal material. This PCR assay can be used in diagnostic laboratories to confirm the presence of C. colinum from pure cultures, and to screen enriched samples or fecal samples for the presence of C. colinum. This assay can also be formatted into an in situ PCR for detection of C. colinum in tissue samples or adapted to a real time PCR for a large screening of enriched or fecal samples.

Key Words: Clostridium Colinum, Bobwhite Quail, Ulcerative Enteritis

T21 Effect of oral administration of *Lactobacillus brevis* on turkey poult performance and immune development. K. Novak*, E. Davis, K. Bos, T. Rehberger, and C. Kromm, *Agtech Products, Inc.*, *Waukesha, WI*.

Immune cell populations in turkey poults were evaluated at d 9, 16, and 37 post-placement in response to dosing with a porcine-derived *Lactobacillus brevis* for the first three days of the brooder phase. Four brooder houses on a commercial turkey farm were evaluated and two treatments were administered orally through the water, such that two brooder houses received *L. brevis* in the water for the first three days after placement, and the other two houses served as controls. Six poults from each house were bled and euthanized at d 9, 16, and 37. Peripheral blood mononuclear cells and intraepithelial lymphocytes from the duodenum were evaluated by flow cytometry to determine T cell subpopulations as defined by the cell surface markers, CD4 and CD8. Poults provided with *L. brevis* had greater ($P = 0.08$) ADG from placement to d 9, but this effect diminished later in the brooder phase such that control birds had greater ($P < 0.01$) ADG from d 9 to 16. The double positive T cell population ($CD4^+CD8^+$) in the peripheral blood did not differ between control and *L. brevis* supplemented birds at d 9, but was greater ($P \leq 0.05$) at d 16 and 37 in *L. brevis* supplemented birds compared to control birds (treatment x day interaction, $P = 0.06$). The $CD4^+$ population in the peripheral blood was lower ($P = 0.08$) in *L. brevis* supplemented birds at d 9 compared to control birds, but was greater ($P \leq 0.07$) than control birds at d 16 and 37 (treatment x day interaction, $P = 0.06$). The $CD8^+$ population in the duodenum did not differ between control and *L. brevis* supplemented birds at d 9, but was lower ($P = 0.02$) at d 16 and greater ($P = 0.09$) at d 37 in the *L. brevis* supplemented birds than control birds (treatment x day interaction, $P = 0.04$). The results of this study indicate that *L. brevis* supplementation to turkey poults at an early age has the potential to improve growth response in the brooder phase and enhance immune development in the gastrointestinal tract and in the peripheral blood. However, duration and timing of administration should be further explored to maintain the performance benefits of early supplementation.

Key Words: Poultry, Probiotic, Immunity

T22 Evaluation of the efficacy of a bio-hygienic additive in ammonia level control in broiler houses. G. Tacconi[1], A. Zanierato*[2], and A. Covarelli[1], [1]*University of Perugia*, *Perugia, PG, Italy*, [2]*SOP Srl*, *Busto Arsizio, VA, Italy*.

The present field study investigates the efficacy of a new bio-hygienic bedding additive (SOP C POULTRY) in ammonia control in broiler houses. Bedding is considered one of the major sources of pollutants; in particular, ammonia often reaches high levels causing limited poultry performance and environmental pollution; the need to manage this using additives, has been considered for the last few years but has not resolved the situation conclusively. This study was carried out during 2003-2006 in an Italian commercial poultry farm. Two large broiler houses, control (C) and treated (T), were selected for their similarity in size, density, ventilation system, drinking and eating equipment. The buildings had a conventional layout and housed about 8,200-8,600 1 day old broiler chicks each cycle, to 7-8 weeks. Bedding consisted of 5-7cm deep wheat straw, regularly changed at the end of each cycle, and treated (T) covering the surface with the additive at a dosage of 2g of additive plus 25g of calcium carbonate (to enable even distribution) per m^2, the day before the chicks' housing and repeated twice a month during the 1st month; after, 1g of additive plus 25g of calcium carbonate per m^2 twice a month, until the end of each cycle. Ammonia concentrations were assessed in each house using Draeger PAC-III (PA-USA) in the 1st and 7th weeks, in six different points. The ammonia mean values of the ten cycles were, in house C and T respectively, in the 1st week 3.90 ± 3.05 ppm and 3.26 ± 3.91 ppm, and in the 7th week 19.07 ± 12.41 and 7.12 ± 4.39. The difference between the mean values was low (P=0.09) in the 1st week, but resulted in a 17.00% reduction; the reduction in the 7th week was significant (P=0.002) 62.9%. The control of ammonia levels in commercial poultry houses is essential in order to: improve the air quality in the housed environment; improve health, performance and welfare of both animals and

human attendants; reduce significantly the environmental ammonia emissions.

Key Words: Ammonia, Poultry, Bedding

T23 Characterization and expression of the ryanodine receptor 2 gene in furazolidone induced cardiomyopathic turkeys. E. Ndegwa* and M. M. Corley, *Tuskegee University*, *Tuskegee, AL*.

Intracellular calcium acts as a secondary messenger involved in signal transduction in almost all body cells and is a major player in contraction and relaxation in muscle cells. Altered calcium cycling is a major hallmark of end stage heart disease and has been linked to altered expression of the calcium cycling proteins. The cardiomyopathic turkey and human hearts have been shown to be similar in terms of the patho-physiological, gross and microscopic lesions. Therefore, investigation of genes involved in turkey cardiomyopathy can lead to further insight into cardiovascular disease in turkeys and serve as a good model for the human condition and thus benefit both the poultry industry and the human population. In this study, we attempted to identify and characterize the ryanodine receptor 2 gene from turkeys that carry a genetic trait (unknown) which renders them susceptible to cardiomyopathy. The ryanodine receptor is the main calcium channel that releases calcium from sarcoplasmic stores in the heart. The expression of this gene as it relates to heart disease in turkeys has not been investigated. Cardiomyopathy was induced in 25 three week old turkey poults by feeding furazolidone (600ppm) over a five week period. A control group (25) was fed regular turkey chick starter without the Furazolidone. Reverse transcriptase polymerase chain reaction (RT-PCR) was performed on total RNA from 0.1g of cardiomyopathic and non cardiomyopathic turkey heart tissue. Primers were designed from the chicken ryanodine 2 gene. The expected 576 bp cDNA fragment was successfully amplified. Nucleotide sequencing will provide verification of this gene. Expression studies will give further insight into the dynamics of the ryanodine 2 gene in cardiomyopathic turkeys and their suitability as a genetic model for human cardiovascular disease.

Key Words: Ryanodine 2, Cardiomyopathy, Turkeys

T24 The effect of anti-coccidiosis antibody on growth performance in broiler chicks. E. Hellestad*, J. Susko-Parrish, and M. E. Cook, *University of Wisconsin*, *Madison*.

A study was conducted to determine the ability of anti-coccidia egg antibody to prevent growth depression resulting from a coccidia challenge. Treatments consisted of control or coccidia challenged chicks factorially arranged (2x2) with adjuvant control egg yolk or anti-coccidiosis egg yolk. 10 pens of 5 chicks were assigned to each experimental treatment. The oral challenge consisted of either 0.2ml water (C) or 0.2 ml 10X commercial coccidiosis vaccine (V) containing viable oocysts of *Eimeria acervulina*, *Eimeria maxima* and *Eimeria tenella* at 0,7, and 14 days. The dietary treatments consisted of freeze dried yolk powder from adjuvant or adjuvant plus coccidia injected hens. The control yolk powder (C) came from hens injected with an emulsion containing Freund complete adjuvant on day 0 and Freund incomplete adjuvant on day 7. Anti-coccidiosis egg yolk (AB) was obtained from hens injected as described above, with the emulsion containing the commercial coccidiosis vaccine at 3mg protein/ml emulsion. Yolks from eggs collected 21-30 days after initial vaccination were freeze dried, powdered and added to a standard chick diet at 1g dried yolk/kg feed. Chicks receiving the vaccine and control diet (V/C) gained significantly less weight over 3 weeks than chicks receiving no vaccine and the control diet (C/C: 574g ±17 vs. 636g ±17, $p<0.05$). Chicks receiving the vaccine and AB diet (V/AB) gained significantly more weight over 3 weeks than the V/C chicks (621g±30 vs. 574g±17, $p<0.05$). V/AB chicks were not significantly different from C/C chicks or chicks on the antibody diet (C/AB) over 3 weeks (621g±30 vs. 636g±17 or 654g±30, $p=0.5$). There were no significant differences in feed efficiency between treatments (C/C= 0.65, V/C=0.65, C/AB=0.66, V/AB=0.65). The growth depression observed in chicks infected with coccidiosis was overcome with the addition of egg yolk containing anti-coccidiosis antibody to the diet.

Key Words: Egg Antibody, Coccidiosis, Broiler Chicks

T25 Oxidative stress and toxin-induced dilated cardiomyopathy in the turkey (*Meleagris gallopavo*). K. Gyenai*, J. Xu, T. Geng, L. Pyle, and C. Larson, *Virginia Polytechnic Institute and State University*, *Blacksburg*.

Dilated cardiomyopathy (DCM) or round heart disease is a muscle disease of the heart which is characterized by ventricular dilatation and abnormal systolic and diastolic left ventricular function. In animals, including turkeys and humans, DCM is the major cause of morbidity and mortality which results from heart failure. In the turkey, DCM can be idiopathic or induced. Here, our primary objective was to determine the effect, if any, of oxidative stress on the incidence and severity of toxin-induced DCM in the commercial turkey. Using glutathione (GSH), malondialdehyde (MDA), and plasma uric acid (PUA) as biomarkers, oxidative stress levels in DCM-affected and -unaffected poults fed varying concentrations of Vitamin E and selenium were also evaluated. Results from the MDA and GSH measurements were inconsistent. However, PUA levels increased by 5-fold between two and four weeks of age in birds fed furazolidone while the increase in non-furazolidone fed control birds was about 150 fold. The effect on the increase in antioxidant status though significant was not consistently affected by feeding either Vitamin E or selenium. Combined with the mortality data, the present work appears to suggest that DCM appears to influence the level of oxidative stress in turkeys.

Key Words: Turkeys, Oxidative Stress, Dilated Cardiomyopathy

T26 Effect of a *Bacillus*-based direct-fed microbial on turkey poult performance and changes within the gastrointestinal microflora. S. Gebert*, C. Kromm, and T. Rehberger, *Agtech Products, Inc.*, *Waukesha, WI*.

Two studies were conducted to evaluate the effect of a *Bacillus*-based direct-fed microbial (DFM) on poult performance and on the gastrointestinal microflora. In both studies, the DFM was incorporated into a standard turkey diet in a commercial facility in the Midwest to provide 4.75×10^4 CFU/g of treated feed. The first study was conducted to evaluate the duration of feeding the DFM on poult performance.

The DFM was fed from placement until the first five weeks of age at 17 sites and from placement to market at 24 sites. Performance was evaluated at market age. The adjusted feed conversion was improved (P = 0.10) in poults fed the DFM from placement to market compared to poults fed the DFM for only the first five weeks after placement. An additional study was conducted in which the poults were fed a standard commercial diet (control) or the control diet supplemented with the DFM from placement to market, and the gastrointestinal microflora was evaluated. Twelve control poults and 10 poults treated with the DFM were euthanized and gastrointestinal tracts were sampled to enumerate avian pathogenic *Escherichia coli* and *Clostridium perfringens* type A. Avian pathogenic *E. coli* encompass a division of pathogenic *E. coli* that cause colibacillosis in young turkey poults. *Clostridium perfringens* type A is an enteric bacterial pathogen and is the major contributing factor associated with necrotic enteritis in poultry. Avian pathogenic *E. coli* and *C. perfringens* type A levels did not differ between control and DFM supplemented poults at 9 weeks of age. However, at 18 weeks of age, supplementation with the DFM reduced avian pathogenic *E. coli* (1.6×10^7 vs. 2.0×10^4 CFU/g; $P < 0.01$) and *C. perfringens* type A (1.9×10^6 vs. 3.6×10^3 CFU/g; $P < 0.01$) compared to control birds. These results indicate that supplementation with a *Bacillus*-based DFM from placement to market improves feed conversion and beneficially alters the gastrointestinal microflora of turkey poults.

Key Words: Poultry, Probiotic, Gastrointestinal Microflora

T27 *Campylobacter jejuni* Colonization Alters Mucin Dynamics And Gut Architecture In Broilers. F. Solis de los Santos*[1], M. L. Dirain[1], P. J. Blore[1], I. Reyes-Herrera[1], A. M. Donoghue[2], and D. J. Donoghue[1], [1]*University of Arkansas*, *Fayetteville*, [2]*Poultry Production and Product Research Unit, Agricultural Research Unit*, *Fayetteville, AR*.

Campylobacter is a significant foodborne pathogen. To our knowledge, the impact of *Campylobacter* colonization on enteric morphology has not been evaluated. Understanding how *Campylobacter* may affect the gut might provide insights into ways to reduce its colonization. To this end, day old chicks (n=108) were randomly allocated in 6 sterile isolators. At d 14, 3 groups of birds (n=36 per group) were orally challenged with 10^6cfu/mL of *C. jejuni*, 10^4 cfu/mL *Salmonella* enteriditis (positive enteric pathogen control) or nothing (negative control), respectively. Six birds from each group were randomly selected at d 7, 14, 21, 28, 35 and 42 for *C. jejuni* enumeration and *Salmonella* detection in the ceca and determination of mucus thickness, villus and crypt depth and goblet cell number and type in the duodenum, jejunum, ileum and ceca. *Campylobacter* and *Salmonella* were detected at d 21, 28, 35 and 42 while negative control birds remained pathogen free. *C. jejuni* colonization decreased mucus thickness in the ileum and ceca on d 42 compared to Salmonella colonized birds and negative control. Ileal acidic goblet cells were reduced in *C. jejuni* and *Salmonella* birds compared to negative control on d 42. Ileal acidic goblet cells were lower in the ceca of *C. jejuni* birds compared to *Salmonella* and negative control on d 35. Ileal sulfuric goblet cells were higher in *C. jejuni* and *Salmonella* treated birds compared to negative control on d 35 and 42. Furthermore, cecal sulfuric goblet cells were higher in *C. jejuni* birds compared to *Salmonella* and negative control on d 28 and on d 42. Ileal crypt depth was lower in *Campylobacter* and *Salmonella* treated birds compared to negative control on d 42. Cecal crypt depth was lower in *C. jejuni* compared to *Salmonella* on d 35 and on d 42 compared to *Salmonella* and negative control. This study suggests that *C. jejuni* colonization alters mucin dynamics and gut architecture in broiler chickens reared in isolation units.

Key Words: *Campylobacter*, Isolator, Mucin

T28 Dietary soybean oil adjust protein and mineral metabolism and antioxidant enzyme activity in male broiler chicks during inflammatory response. T. S. Koh*, C. R. Choi, M. J. Chang, K. C. Lee, and S. Y. Kim, *Konkuk University*, *Seoul, South Korea*.

In order to study an effect of dietary soybean oil on protein metabolism during inflammatory response, two experiments were conducted in male broiler chicks. In experiment 1, Dietary soybean oil decreased urinary nitrogen (UN) in excreta, and improved BV (protein retention/AN) of protein and ash retention, but did not altered digestibility of protein. In experiment 2, compared with birds fed basal diet, in broiler chicks activated inflammatory response, soybean oil 5.0% diet increased daily gain, and feed efficiency, dietary protein utilization (NB/NI; BV:NB/absosbed N) ($p<0.05$), activity($p<0.05$) of CuZnSOD or MnSOD in erythrocyte cytosol, and activity of ceuloplasmin in liver cytosol and plasma. Also soybean oil 5.0% diet decreased fecal nitrogen (FN/NI) and urinary nitrogen (UN/NI) in excreta ($p<0.05$) but did not affect dietary calcium or phosphorus balances. Compared with control birds, in birds fed soybean oil 5.0% diet, the inflammatory response did not affect daily gain and feed efficiency, the excretion of FN/NI or UN/NI, NB/NI and BV of dietary protein, calcium or phosphorus balances, and CuZnSOD activity in liver cytosol, but reduced the feed consumption and significantly the MnSOD activity in liver cytosol, and increased significantly the CuZnSOD or MnSOD activity in erythrocyte cytosol and tended to enhance the ceruloplasmin activity in plasma but in liver cytosol. These results indicated that the improvement (extra calorific effect) of assayed ME value in soybean oil was partly due to decreased heat increment by enhanced lipid retention and biological value of dietary protein and ash retention. And the alleviatin of inflammatrory response in broiler chicks fed dietary soybean oil is interacted with decreased protein decomposition and changed activities of superoxide dismutase and ceruloplasmin

Key Words: Inflammatory Response, Biological Value of Protein, Antioxidant Enzyme Activity

T29 Prevalence of gastrointestinal parasites in sheep of the Brisas Town, Culiacán, Sinaloa. M. C. Rubio Robles*, S. M. Gaxiola, C. N. Castro, D. J. Zazueta, G. A. Felix, and E. Sanchez, *Universidad Autonama de Sinaloa*, *Culiacan, Sinaloa, Mexico*.

The objective of this work was to determine the prevalence of gastroenteric parasites in ovine of the town the Brisas, municipality of Culiacán, Sinaloa, which counts on a total of 260 animals (163 adults and 97 young); the sampling was representative in each explotaction, considering itself the young and adults without determining the race and cradle in the technique of sampling of population described by Thrusfield (1995), that is next: Where: n: sample size, t: value of the normal distribution (t of Student) for a level of confidence of 95% (t it is 1.96), L: accepted error or precision (5%), SD: "waited for

Prevalence of disease (%). On the basis of the mentioned technique the total number of samples animals was of 59; of each ovine were collected feces of the rectum of the animal directly, using plastic bags previously identified. The samples was transported under refrigeration to 4º C and it was sent to the Parasitology laboratory of the FMVZ-UAS, where process by the sedimentation technique; being the 100% from the positive samples to gastroenteric parasites with a prevalence of 94.9% (56 ovines) to some of the following parasites: 78.8% (46) positives to Eimeria spp., 35.6% (21) to Moniezia spp., 11.9% (7) Strongyloides spp. 8.5 % (5)Haemonchus spp., 6.8 % (4) to Buxtonella spp and 3.4% (2) to Trichuris spp. it is concluded that exists high prevalence of gastroenteric parasites in ovines in the town of Brisas, municipality of Culiacán, in the state of Sinaloa. Reason why is advisable to make studies in which determines the parasitic quantity as well as its effects in the ovine production.

Key Words: Parasites, Ovines, Prevalence

T30 Presence of *Mycoplasma sp.* in lambs with lung lesions. J. A. Daniel*[1], J. E. Held[2], and L. Holler[2], [1]*Berry College*, *Mount Berry, GA*, [2]*South Dakota State University*, *Brookings*.

Previous research in cattle and sheep has indicated that lung lesions result in decreased animal growth, and lung lesions in sheep are often associated with *Mannheimia haemolytica* and *Pasteurella multocida* infection in the lungs. The purpose of this research was to identify other bacterial agents associated with lung lesions. White-faced, Polypay-sired, February born wether lambs from the South Dakota State University (SDSU) Sheep Unit were utilized for this study (n = 76). After weaning, lambs were fed a high concentrate finishing diet *ad libitum* in the same barn with natural ventilation. Lambs were transported to a commercial packing plant in two groups for harvest. The first group was harvested when a minimum of 30 lambs were estimated to have a hot carcass weight over 27.2 kg, and the second group was harvested when 66% of the remaining lambs were estimated to have a hot carcass weight over 27.2 kg. Lungs were collected at slaughter, and transported on ice to the SDSU Animal Disease Research and Diagnostic Laboratory. Lungs were classified as having normal (<5 % consolidation of any lobe; n = 13), moderate lesions (5-50% consolidation of any lobe; n = 8) or severe lesions (>50% consolidation of any lobe; n = 61). A portion of the right cranial lobe of each lung was collected. Samples of lungs were cultured aerobically and for *Mycoplasma sp.* As observed previously, culture analysis confirmed the presence of *M. haemolytica* and *P. multocida*. Additionally, *Mycoplasma sp.* were detected. Data were tested for effect of lung lesion prevalence or severity on the detection of *Mycoplasma sp.* by Chi square analysis. *Mycoplasma sp.* was cultured from a greater percentage of lungs with lesions than normal lungs (51% vs. 15% respectively, $P = 0.04$). However, the severity of the lung lesions did not affect the percentage of lungs which had positive cultures for *Mycoplasma sp.* (38% vs. 53% for moderate vs. severe lung lesions, $P = 0.42$). These results indicate *Mycoplasma sp.* may play a role in the formation of lung lesions.

Key Words: Lambs, Lung lesion, *Mycoplasma sp.*

T31 Effects of herbal and chemical deworming agents on internal parasite control comparing fecal egg counts, hematocrits and FAMACHA(R) on sheep and goats. H. Swartz*[1], A. Stewart[1], F. Wulff[1], D. Sommerer[1], and M. Ellersieck[1,2], [1]*Lincoln University*, *Jefferson City, MO*, [2]*University of Missouri*, *Columbia*.

An herbal dewormer was compared with the commercial Ivomec dewormer in two groups of sheep and a group of Boer/cross goats plus a control group in 2006. Katahdin hair sheep, Dorset wool sheep and Boer/cross goats (n=36) were fed herbs consisting of 40.5% wormwood (Artemisia sp.), fennel (Foeniculum vulgare), gentian (Gentian sp.), psyllium (Plantaga sp.) and quassia (Quassia sp). All treatment groups were dewormed with Cydectin at the beginning of the project. Herbs were fed to the three breeds once a week in a corn based ration from June through October. Ivomec was drenched every 30 days from July through October to both the Katahdin and Dorset sheep at the rate of 3 ml to 11.8 kg body weight and Boer/cross goats at the rate of 4.5 to 11.8 kg body weight. The control group received no treatment. Fecal eggs counts (FEC) were collected at the beginning of the project in all three treatment groups, hematocrits and FAMACHA® were scored at the same time throughout the project. Results of breed differences in FEC, hematocrits and FAMACHA® statistically reported ($P<.0001$), lowest count in the Katahdin and highest in the Dorset, over time ($P<.0001$) and interactions of breed x time x treatment ($P<.0001$). The FEC peaked in July, hematocrits and FAMACHA® readings lowered showing the Hoemonchus contortus barberpole blood sucking stomach worm a hot weather worm. Seasonal differences were also observed in the hematocrits and FAMACHA® results in breed, time and treatment in the trial. The results of this study suggest that herbs are effective in controlling internal parasites in Katahdin sheep and Boer goats throughout the hot summer months.

Key Words: Herbs, FAMACHA®, Deworming

T32 Indirect contact: A possible dissemination route of Caprine arthritis encephalitis among goat kids. A. Asmare*[1,2], K. E. Washburn[3], J. T. Saliki[4], A. L. Goetsch[1], L. J. Dawson[5], R. C. Merkel[1], and T. Sahlu[1], [1]*E (Kika) de la Garza American Institute for Goat Research, Langston University*, *Langston, OK*, [2]*Alemaya University*, *Dire Dawa, Ethiopia*, [3]*Texas A&M University*, *College Station*, [4]*Oklahoma Animal Disease and Diagnostic Laboratory*, *Stillwater, OK*, [5]*Oklahoma State University*, *Stillwater*.

Twenty Alpine goat kids were randomly assigned to four groups of five animals. Kids were removed from their dams at birth and penned individually. Kids in all groups were fed colostrum during the first 48 h after birth. Group 1 was fed Caprine arthritis encephalitis virus (CAEV) free colostrum, Group 2 received CAEV positive colostrum, Group 3 consumed CAEV positive colostrum subjected to conventional heat treatment, and Group 4 was given CAEV positive colostrum treated with methylene blue and fluorescent light. Thereafter, all kids were fed pasteurized goat milk until weaning. No CAEV specific antibodies were detected in serum of any kids collected prior to colostrum consumption. Despite efforts to aviod vertical transmission of the virus among kids , three goat kids of Group 1 showed seroconversion at the age of 48 h and the remaining two kids displayed seroconversion at 2 months of age. All animals in Groups 2, 3, and 4 had seroconvertion at the age of 48 h. Presence of CAEV was confirmed in 17 kids (85%) by polymerase chain reaction at the age of 1.5 months. The early appearance of CAEV specific antibodies was

probably caused by consumption of antibody containing colostrum and maintenance of maternal antibodies. Results of this study suggest that factors other than direct contact of kids with their dams i.e. ingestion of infected colostrum and milk could be means of CAEV transmission. Therefore, the risk of indirect contact in the dissemination of CAEV should be taken into account in control and eradication programs.

Key Words: Caprine Arthritis Encepahlitis Virus, Goats, Colostrum

T33 Identification of Cydectin targets in *C. elegans*. M. Worku*, O. Alexander, and P. Matterson, *North Carolina Agricultural and Technical State University*, *Greensboro*.

Model systems such as the free living nematode *Caenorhabditis elegans* (*C. elegans*) are being used to identify drug targets. With the availability of the genome sequence it can be used to study the function and expression of drug target genes on a global scale. Macrocyclic lactones are chemical compounds that represent the main treatment for parasitic diseases of animals. The objective of this study was to evaluate the effect of cydectin on global gene expression in *C. elegans* to identify drug targets that may contribute to the development of anit-helminthic resistance. Nematodes were grown and exposed to 7 ml of a sub-lethal dose of Cydectin (Quest®Gel), (0.016 mg/ml in sterile water) and washed in PBS. Controls were exposed to PBS. RNA was isolated using RNeasy (Qiagen) kits. RNA integrity and size distribution was checked on a bioanalyzer. Total *C. elegans* array chips (Washington State University) were used for expression profiling. A dye swap system was used (N= 6 slides). Data acquired using Jaguar analysis software was analyzed using Magic tool. Differential gene expression was observed. Twenty up or down regulated genes/array slide (200 total) were selected. Four fold differences were used to select genes common to five slides used. Exposure to Cydectin resulted in increased transcription, (3.06 ug in controls, 4.89 ug treated). In addition to genes with unknown function we have identified two genes that may be the site of action of cydectin, PtP3 and unc-11. Unc-11 is a highly conserved gene that functions to regulate the neuronal network that controls the pharynx. PtP3 is a phosphatase which may be important in post transcriptional modification. Further studies are needed to define the pathways of action. Characterization of these genes may contribute to the understanding of the molecular basis for drug resistance and genetic diversity of nematodes.

Key Words: *C. elegans*, Nematode, Drug Target

T34 Composition of amino acids in typical Chinese herbs is not unique among feeds of plant origin. X. Wu*[1], X. F. Kong[1], Y. L. Yin[1], F. G. Yin[1], P. Zhang[1], H. J. Liu[1], F. F. Xing[1], Q. H. He[1], T. J. Li[1], R. L. Huang[1], and G. Y. Wu[1,2], [1]*Institute of Subtropical Agriculture, The Chinese Academy of Sciences*, *Changsha, Hunan, China*, [2]*Texas A&M University*, *College Station*.

As an initial step to define the mechanisms responsible for the beneficial effects of typical Chinese herbs on health and growth performance of swine and poultry, we determined concentrations of CP and amino acids in *Astragalus membranaceus, Acanthopanax senticosus, Salvia miltiorrhiza bunge, Crataegus pinnatifida Bge, and Salvia miltiorrhiza Bge*. Ten representative samples for each herb were hydrolyzed in 6 N HCl under nitrogen at 110°C for 24 h and the resultant amino acids were determined using an automatic amino acid analyzer. Results are expressed on the DM basis. Concentrations of CP in these five Chinese herbals were 14.1%, 13.9%, 3.06%, 2.06%, and 6.28%, respectively. Concentrations of total amino acids in *Astragalus membranaceus, Acanthopanax senticosus, Salvia miltiorrhiza bunge, Crataegus pinnatifida Bge, and Salvia miltiorrhiza Bge* were 10.6%, 2.84%, 3.43%, 3.99%, and 7.02%, respectively. Concentrations of Arg, Lys, Glu+Gln, branched-chain amino acids, and Asp+Asn in *Astragalus membranaceus* were 0.64%, 1.08%, 1.37%, 1.49%, and 1.64%, respectively. Concentrations of Arg, Lys, Glu+Gln, branched-chain amino acids, and Asp+Asn in *Salvia miltiorrhiza Bge* were 0.77%, 0.36%, 1.05%, 1.10%, and 0.64%, respectively. The composition of amino acids in the Chinese herbs is largely similar to that in feeds of plant origin. These results indicate that typical Chinese herbs are not unique in the composition of protein-precursor amino acids among plants. Other components in the herbs are likely major active components that beneficially regulate intestinal barrier integrity, nutrient metabolism, immune function, health, and growth in animals. (Supported by NSFC and CAS)

Key Words: Chinese Herbs, Amino Acids, Nutritive Value

Beef Species

T35 Effects of season and bull breed of semen on pregnancy rate in beef cattle. K. Kreausukon[1], S. Teepatimakorn[2], P. Vinitchaikul*[1], P. Yamsakul[1], and W. Suriyasathaporn[1], [1]*Chiang Mai University*, *Muang, Chiang Mai, Thailand*, [2]*Chiangmai Artificial Insemination Research and Biotechnology Center*, *Muang, Chiang Mai, Thailand*.

The objectives of this study were to identify the factors associated with conception risk in beef cattle. Data of artificial insemination of beef cows during September 2003 to October 2004 recorded by AI center were used. The data included bull breed of semen, date of artificial insemination, and results of pregnancy check. Season included winter (Nov-Feb), summer (Mar-May), and rainy (Jun-Oct). Bull breed of semen included Charolais (CHA) and American Brahman (AB). The generalized estimating equation (GEE) was used to analyze the effect of season and bull breed of semen on pregnancy rate. The final data included 2,823 observations. Overall pregnancy rate was 79.14%. The pregnancy rates for winter, summer, and rainy seasons were 82.5, 83.2, and 74.4%, respectively, and the rates for CHA and AB were 78.5 and 83.1%, respectively. Results from GEE showed that both factors were associated with pregnancy rate ($P<0.05$). In comparison to rainy season, beef cattle inseminated during winter and summer seasons had higher conception risks (OR = 1.63 and 1.71, respectively). Beef cattle inseminated with semen from American Brahman bull had lower pregnancy risk than the semen from Charolais bull (OR=0.74). In Thailand, the high temperature with high humidity might cause more heat stress in cattle. In conclusion, pregnancy risks in beef cattle are associated with season and bull breed of semen.

Key Words: Season, Beef, Conception

T36 TG-repeat microsatellites of growth hormone receptor and their associations with growth performances in Angus Plus calves raised on subtropical pasture. J. Yang*[1], J. Lee[1], R. Ferreira[2], M. DuPonte[1], and G. Fukumoto[1], [1]*University of Hawaii*, *Honolulu*, [2]*Olumau Angus Plus LLC*, *Lihue, HI*.

Growth hormone receptor (GHR) plays a significant role in animal growth through mediating the actions of growth hormone on the target cells. A polymorphic microsatellite (TG)n, located 90 base pairs upstream of the GHR gene, has been associated with growth performances in beef cattle. The 16-20 TG-repeat, named long allele (L), are mostly presented in Bos taurus breeds while the 11 TG short allele (S) is common in Bos indicus cattle. Angus Plus cattle are bred by maintaining a minimum o 4% Brahman in the Angus or Brangus breed. To investigate allele distributions of the microsatellite and their applications to growth trait selection, we genotyped the GHR microsatellites by PCR amplification and DNA fragment analysis, and compared growth performances between different genotypes of the GHR microsatellite. Calves were raised on 100% improved pastures of Pangola Rhodes and Guinea throughout the year in Kauai Island. Data for birth weight (BWT), 205-adjusted pre-weaning weight (PWT) and average daily gain (PWADG), hip height at birth and weaning (HHB and HHW) were obtained. Data were analyzed by MIXED procedure of SAS and all means were generated from LSMEAN. The frequency of long and short allele was 80.2% and 19.8% in the herd (N=96), respectively. Calves with LL, SS and SL genotype had BWT of 35.52±0.97, 34.21±0.91, 31.02±2.00 kg, respectively; the mean of analyzed growth traits of SL genotype is between SS and LL genotypes. No significant associations (P>0.1) of the GHR genotypes with growth traits (BWT, PWT, PWAGT, 68-d post-weaning ADG, HHB, HHW) were observed in the calves (n=42) born in 2004. Based on a limited number of the animals, the results demonstrate a moderate frequency of short GHR allele in the current Angus Plus herd. The application of this GHR microsatellite genotyping to selection of growth traits needs to be further validated with a large number of animals.

Key Words: Angus Plus Cattle, Growth Hormone Receptor, DNA Polymorphism

T37 Influence of dietary roughage source on growth performance and carcass characteristics of Korean native cattle (Hanwoo). S. O. Lee[1], K. K. Jung[1], C. B. Choi[1], and I. S. Jang*[2], [1]*Yeungnam University*, *Daegu, Korea*, [2]*Jinju National University*, *Jinju, Korea*.

Korean native beef cattle (Hanwoo) destined for production of high-quality grade beef must be castrated, and fed for a long time to achieve highly-marbled beef deserving of premium prices. The objective of this study was to determine whether dietary roughage source during the growing and fattening periods would affect growth performance and characteristics of carcass in Hanwoo cattle. Traditionally, the entire feeding period (2 yr) is divided into the growing (6 to 13 month), fattening (14 to 22 month) and finishing phases (23 to 30 month). A total of 35 Hanwoo, half-sib calves (initial BW 163±11.0 kg, housed in 7 pens of 5 calves/pen) were allotted to one of two dietary roughage sources (Control vs.Treatment). Steers in the treatment group were fed timothy hay as the only source of roughage, while control steers received a combination of timothy and alfalfa hay, and rice straw during the growing (up to 4.0kg/head/day) and fattening (down to 1.5kg/head/day) periods. Dietary source of roughage did not affect ($P > 0.05$) growing performance (ADG and BW) or feed efficiency in during the growing, fattening or the entire feeding period. Feeding timothy hay as the only roughage source resulted in 15% increased profit ($P < 0.05$) compared with the control. Back fat thickness($P = 0.28$), longissimus area (P=0.13), and yield grade (P=0.36) in carcasses from steers in the treatment group tended to be improved by 10%, 6.6% and 6.9%, respectively. However, marbling score and quality grade were similar in the two groups. The physico-chemical characteristics of carcasses including moisture, CP and drip loss were unaffected ($P > 0.05$) by dietary roughage source. In conclusion, feeding timothy hay was beneficial for the production of Hanwoo steers due to greater yield grade and improved profit, although growth performance and carcass quality were unaffected by roughage source.

Key Words: Hanwoo Beef Cattle, Dietary Roughage Source, Carcass Quality

T38 Predicting beef carcass retail products of Mediterranean buffaloes by real-time ultrasound measures. A. M. Jorge*, C. Andrighetto, C. L. Francisco, A. P. Neto, and R. C. Mourão, *Sao Paulo State University*, *Botucatu, SP, Brazil*.

Twenty eight Mediterranean buffaloes bulls were scanned with real-time ultrasound (RTU), slaughtered, and fabricated into retail cuts to determine the potential for ultrasound measures to predict carcass retail yield. Ultrasound measures of fat thickness, ribeye area and rump fat thickness were recorded three to five days prior to slaughter. Carcass measurements were taken, and one side of each carcass was fabricated into retail cuts. Stepwise regression analysis was used to compare possible models for prediction of either kilograms or percent retail product from carcass mesaurements and ultrasound measures. Results indicate that possible prediction models for percent or kilograms of retail products using RTU measures were similar in their predictive power and accuracy when compared to models derived from carcass measurements. Both fat thickness and ribeye area were over-predicted when measured ultrasonically compared to measurements taken on the carcass in the cooler. The mean absolute differences for both traits are larger than the mean differences, indicating that some images were interpreted to be larger and some smaller than actual carcass measurements. Ultrasound measurements of REA and FT had positive correlations with carcass measures of the same traits (r=.96 for REA and r=.99 for FT). Standard errors of prediction currently are being used as the standard to certify ultrasound technicians for accuracy. Regression equations using live weight (LW), rib eye area (REAU) and subcutaneous fat thickness (FTU) between 12th and 13 th ribs and also over the biceps femoris muscle (FTP8U) by ultrasound explained 95% of the variation in the hot carcass weight when measure immediately before slaughter.

Key Words: Ribeye Area, Rump Dat, Backfat Thickness

T39 Correlations among carcass traits taken by ultrasound and after slaughter in Mediterranean (Bubalus bubalis) buffaloes. A. M. Jorge*, C. Andrighetto, R. S. B. Pinheiro, C. L. Francisco, and A. P. Neto, *Sao Paulo State University*, *Botucatu, SP, Brazil*.

The objective of this work was to estimate the correlations among measurements taken in vivo with ultrasound equipment with some

carcass traits measured after slaughter. Twenty eight Mediterranean bulls, with average shrunk body weight of 330 kg and 14 months of age, were fed high concentrate diets for 120 d. Shrunk body weight, ribeye area (REAU), fat thickness (FTU) over the Longissimus dorsi muscle between 12th and 13th ribs, and rump fat (EGP8U) were measured at 28-d intervals. A Piemedical Scanner 200 VET real time ultrasound scanner, with 18 cm linear array transducer, was utilized. After slaughter, hot carcass weight (PCQ) and kidney, pelvic and inguinal fat (GRPI) were weighed and dressing percentage (DP) calculated. After 24 hours of cooling, ribeye area (REAC), fat thickness (FTC) and rump fat (EGP8C) were measured. The REAC, FTC and EGP8C were underestimated by ultrasound measurements. The Pearson correlation coefficients for ribeye area, backfat thickness and rump fat measured in the carcass with ultrasound measurements were 0.96, 0.99 and 0.91, respectively. The correlation between DP and REAU was 0.47; 0.45 between DP and REAC, 0.56 between DP and FTU and 0.58 between DP and FTC. Dressing percentage had a correlation of 0.59 with EGP8U. Spearman correlations estimated between REAU and REAC, FTU and FTC, EGP8U and EGP8C, were 0.96, 0.99 and 0.91, respectively. Ultrasound measures could be used to estimate carcass traits in buffaloes with acceptable accuracy.

Key Words: Ribeye Area, Rump Fat, Backfat Thickness

T40 Influence of shade in pen on performance of feedlot calves received during the autumn in the Northwest of Mexico. R. Barajas*[1], B. J. Cervantes[2,1], E. A. Velazquez[1], F. Juarez[1], and J. A. Romo[1], [1]*FMVZ-Universidad Autonoma de Sinaloa*, *Culiacan, Sinaloa, Mexico*, [2]*Ganadera Los Migueles SA de CV*, *Culiacan, Sinaloa, Mexico*.

Sixty Brahman cross bull calves (BW = 244 kg) were used in a 28-d feedlot experiment to determine the influence of shade on performance during the autumn in Northwest Mexico (24° 50′ N-latitude and 107° 26′ W-longitude). Calves were blocked by weight and placed in each of six dirt-surfaced shaded pens (5 hd/pen) providing 3.4 m^2 of shade/head or in six unshaded pens. Calves were fed ad libitum a 20% CP receiving diet containing (DM basis) 44% corn silage, 17% corn straw, 10% ground corn, 22% soybean meal, 3% meat and bone meal, 3% mineral premix, and 1% buffer premix twice daily. Calves were weighed on days 1, 14 and 28. Air temperature, soil temperature and relative humidity were recorded daily at 1400 h. Shade decreased (P = 0.08) air (32.3 vs. 31.4°C) and soil (P < 0.01) temperature (33.9 vs. 31.6°C). Relative humidity was not affected (P = 0.18) by shade (38.13 vs. 41.85%), and THI was similar (P = 0.60) between treatments (79.03 vs. 78.66). Over the 28-d experiment, use of shade increased (P = 0.05) ending weight (280.8 vs. 285.8 kg) 1.9% and (P = 0.06) average daily gain (1.30 vs. 1.47 kg/d) 12%. Dry matter intake measured both as daily intake or percentage of body weight was not altered (P > 0.13) by shade. Feed/gain ratio was similar (P = 0.14) in both treatments. A 30% of compensatory growth estimated as observed/expected NEm ratio was shown by calves during the complete 28 d trial, mostly due to 65% impetus displayed during the first 14 d, the remainder time (d 15 - 28) observed/expected NEm ratio was 0.98. These results suggest that shade in feedlot pen contributes to enhance performance of calves during their first two weeks in the feedlot.

Key Words: Feedlot, Bulls, Shade

T41 Effect of weaning and post-weaning management of beef steers on carcass characteristics and tenderness. A. E. Radunz*, H. N. Zerby, J. F. Grimes, G. D. Lowe, and F. L. Fluharty, *The Ohio State Univeristy*, *Columbus*.

To evaluate effect of weaning and post-weaning management on carcass characteristics and tenderness, 104 steers from a closed Angus herd, born over a four year period, were assigned to one of three weaning management systems based upon chronological birth order. The management systems were 1) early weaned (EW) at 100 days of age (DOA); 2) normal weaned (NW) at 200 DOA; 3) yearlings (YR) weaned at 200 days of age and fed a forage-based diet until 400 DOA. Steers were fed a finishing diet starting a 100, 200, and 400 DOA for EW, NW, and YR, respectively. The finishing diet contained 65% whole corn, 15% timothy hay, 12 % soybean meal, and 8% vitamin/mineral supplement and was formulated to contain 14.6% CP, 2.019 NE_m, and 1.371 NE_g. Cattle were harvested at 395, 415, and 540 ± 5.0 DOA for EW, NW and YR, respectively. Two steaks were removed from 12th rib location, aged for 72 h and 14 d, and used to determine Warner-Bratzler shear force (WBS). Data were analyzed using the MIXED model of SAS with year as a random variable and mean separation by LSD ($P = 0.05$). Yearling steers had greater ($P < 0.05$) hot carcass weights compared to EW and NW steers (344.0, 329.5 and 328.8 ± 3.6 kg, respectively). Weaning and post-weaning management had no affect on ribeye area; however, carcasses from YR had less ($P < 0.05$) 12th rib fat than from EW and NW steers (1.18, 1.63 and 1.52 ± 0.07 cm, respectively), which resulted in lower ($P < 0.05$) USDA yield grade (3.25, 3.61 and 3.60 ± 0.11, respectively). Conversely, carcasses from EW and NW steers had greater ($P < 0.05$) marbling scores than from YR (582.0, 558.7, and 494.1 ± 26.66, respectively). Steaks from YR steers' carcasses had greater ($P < 0.05$) WBS than from EW and NW at both 72 h (5.56, 3.94, and 2.73 ± 0.22 kg, respectively) and 14 d (4.12, 3.88 and 2.85 ± 0.29 kg, respectively). Weaning age and post-weaning management systems in which steers are harvested at an older age can result in heavier carcass weights, less backfat, lower quality grades and tougher steaks.

Key Words: Beef, Weaning Manangement, Meat Quality

T42 Effect of Wagyu- versus Angus-sired calves on feedlot performance, carcass characteristics, and tenderness. A. E. Radunz*, H. N. Zerby, S. C. Loerch, G. D. Lowe, and F. L. Fluharty, *The Ohio State Univeristy*, *Columbus*.

Thirty-nine Wagyu-sired (n = 21; WAG) and Angus-sired (n = 19; ANG) steers and heifers were used to compare the effects of sire breed on feedlot performance, carcass characteristics and meat tenderness. Calves were weaned at 138 ± 15.7 d of age and individually fed a finishing diet consisting of 65% whole corn, 20% protein/vitamin/mineral supplement, and 15% corn silage on a dry matter basis. Heifers and steers were harvested at 535 and 560 kg, respectively. Carcasses were ribbed between the 12th and 13th (USDA grading system) and the 5th and 6th ribs (Japanese grading system) to measure fat thickness, longissimus muscle area (LMA), and intramuscular fat (IMF). Two steaks were removed from the 12th rib location and aged for 72 h and 14 d to determine Warner-Bratzler shear force (WBS) and cooking loss. Data were analyzed using the MIXED procedure of SAS. Breed of sire by gender interactions were not significant ($P > 0.05$). Angus-sired calves had greater ($P < 0.05$) ADG and DMI and improved ($P < 0.05$) G:F than WAG. Breed of sire

did not affect hot carcass weight, 12th rib fat, USDA yield grade, or percentage boneless closely trimmed retail cuts ($P < 0.05$). Carcasses of WAG had greater ($P < 0.001$) marbling scores at the 12th rib than those of ANG (770.9 vs 597.3 ± 41.01, respectively). Carcasses of WAG also had greater ($P < 0.05$) 12th rib IMF (12.91 vs 10.54 ± 1.00 %), and 5th rib IMF (15.15 vs 11.90 ± 0.956%) than ANG. Carcasses from WAG tended ($P < 0.07$) to have greater LMA at 12th rib, while ANG carcasses had greater ($P < 0.05$) LMA at 5th rib. Sire breed did not affect ($P < 0.05$) tenderness following aging for either 72 h or 14 d. Cooking loss was greater ($P < 0.05$) for ANG than WAG steaks at 72 h and 14 d. Angus-sired calves had greater feedlot performance; however, the resulting carcasses of Wagyu-sired calves had greater marbling with no difference in percentage of retail product and tenderness at a similar harvest weight.

Key Words: Angus, Wagyu, Meat Quality

T43 Impact of using proven genetics in an AI program. D. J. Schafer*[1], J. K. Haden[1], S. R. Bartholomew[1], M. T. Griffin[1], M. E. John[1], J. L. Parcell[2], and D. J. Patterson[2], [1]*MFA Inc.*, *Columbia, MO*, [2]*University of Missouri*, *Columbia*.

This experiment evaluated the economic impact of using proven genetics in an AI program. Steers (n = 328) representing 4 sire groups from 4 locations were vaccinated, fed standardized nutrition and weaned for a minimum of 45 d before placement in the same feedlot. Steers were the result of AI and natural service (NS) matings. Sires of these steers were categorized on the basis of EPD accuracies: High Accuracy AI (HA); Low Accuracy AI (LA); Calving Ease AI (CE); or NS. HA sires were bulls with EPD accuracies ≥ 0.85 for BW, WW, and YW. Steers were assigned to pens within sire groups by weight, and received the same ration throughout the duration of the trial. Individual carcass measurements were collected for all steers at harvest, which was performed at the same commercial packing facility. Steers were determined to be finished based on ultrasound measurements and fat deposition patterns. Feeder calf value was determined using the Kansas State University price slide equation based on the 3 yr average of fed cattle and corn futures. Carcass value was determined using a 3 yr average of USDA reported values to establish fixed values for base price, premiums, and discounts to eliminate any market seasonality. Although all sire groups were harvested at the same yield grade (P = 0.18), steers sired by HA sires finished relative to all other sire groups at a younger age (P < 0.0001; HA, 408 d; LA, 430 d; CE, 443 d; NS, 416 d) with better average quality grades (P < 0.0001; HA, Choice +; LA, Choice -; CE, Choice; NS, Choice -). Steers sired by HA sires also finished with more (P < 0.0001) net return than the other sire groups (LA, $50.69; CE, $53.83, NS, $89.66). The estimated lifetime value of the HA sired replacement females compared to the NS sired replacement females ranged from $248.43 (4 yr expected productive life) to $416.40 (7 yr expected productive life). Artificial insemination to sires with high accuracy EPDs provides the opportunity to increase profitability and marketability of both terminal and replacement female calf crops. Furthermore, AI to HA sires offers the greatest probability of making improvements in the traits to which selection pressure is applied.

Key Words: AI, EPD, Economics

T44 Performance and carcass characteristics of straightbred and crossbred Bonsmara and Tabapua steers at the same carcass weight. E. L. A. Ribeiro*, I. Y. Mizubuti, L. D. F. Silva, M. A. Rocha, and S. M. Climaco, *Universidade Estadual de Londrina*, *Londrina, Brazil*.

This experiment was carried out to evaluate the performance of steers of four genetic groups: 1) Bonsmara (B), 2) ½ Bonsmara - ½ Nelore (B1), 3) ½ Bonsmara - ¼ Red Angus - ¼ Nelore (B2), and 4) Tabapua (T). Twenty animals, 22 mo of age at the initiation of the study, were maintained under the same conditions in a feedlot, in the state of Parana, Brazil. The five steers of each genetic group were collectively fed. They were slaughtered, on average, after 112 d in feedlot. Traits were evaluated on a final carcass weight (260 kg) basis. Initial weight was also used as covariate in the statistical analyses. Tabapua steers were lightest (P<0.05) at slaughter, had the lowest (P<0.05) average daily gain (ADG), but the greatest (P<0.05) dressing percentage (55.2%). Averages for live weight at slaughter and ADG were: 493, 490, 506 and 471 kg, and 1.035, 0.952, 1.122 and 0.630 kg, respectively, for B, B1, B2 and T. Tabapua steers needed 43 more days (P<0.05) to achieve the same carcass weight than Bonsmara steers. Bonsmara steers had the largest (P<0.05) ribeye area (82.9 cm^2) and percentage of muscle (68.2%) in the carcass, and the lowest percentage of fat (17.1%). Averages for subcutaneous fat thickness were 3.7, 8.8, 7.0 and 4.5 mm (P<0.05), respectively, for B, B1, B2 and T. Percentages of carcass cuts (sawcut, forequarter and sidecut) were similar (P>0.05) among the genetic groups. Meat tenderness measured by a texturometer fitted with a Warner-Bratzler shear attachment were 4.9, 5.6, 4.9 and 7.3 kgf (P<0.05), respectively, for B, B1, B2 and T. Straightbred and crossbred Bonsmara steers had similar performance, on the other hand the zebu (Tabapua) steers produced less tender meat.

Key Words: Crossbreeding, Meat, Zebu

T45 Efficacy of rumen temperature boluses for health monitoring. T. K. Dye*, C. J. Richards, L. O. Burciaga-Robles, C. R. Krehbiel, and D. L. Step, *Oklahoma State University*, *Stillwater*.

Remote rumen temperature monitoring is a potential method for early disease detection in beef cattle. The objective of this experiment was to determine the efficacy of disease detection using remote monitoring rumen temperature boluses (SmartStock, LLC) in steers challenged with Bovine Respiratory Disease pathogen (*Mannheimia haemolytica*) following exposure to Bovine Viral Diarrhea (BVD). Twenty-four Angus crossbred steers (initial BW=305 ± 20 kg) were allotted to 4 treatments: 1) no challenge (Control); 2) challenge with *M. haemolytica* (MH); 3) 72 h exposure to persistently infected BVD steers (BVD); and 4) 72 h BVD exposure and challenged with *M. haemolytica* (BVD+MH). Remote monitoring rumen temperature boluses programmed to transmit temperature every minute were placed in the rumen prior to the time of exposure to persistently infected BVD steers. Rectal temperatures were taken prior to MH challenge (0) and 2, 4, 6, 12, 18, 24, 36, 48, 72 and 96 h post challenge. Rumen temperatures were recorded for 14 d post MH challenge. Rumen temperatures were analyzed using repeated measures analysis using a first-order autoregressive covariance structure. Average daily rumen temperature resulted in a treatment x day interaction (P < 0.01). Steers challenged with MH had increased rumen temperatures on d 1 and 2 post MH challenge, whereas steers exposed to BVD had increased rumen temperatures on d 6 and 7. Post MH challenge, hourly rumen temperature peaked

at approximately 8 h for MH and 112 and 136 h for BVD. Maximum rumen temperature was increased ($P < 0.02$) for the MH (1.32°C), BVD (0.54°C) and BVD+MH (1.44°C) steers. On average, rumen temperature measured by the boluses at the same time points as the rectal temperatures were 0.19°C lower than rectal temperatures with a R^2 of 0.78. Rumen temperature boluses appear to have potential as a tool for detecting responses to adverse health events such as exposure to BRD and BVD.

Key Words: Rumen Bolus, Temperature Monitoring, Health Monitoring

T46 Relationships between MUFA ratio of marbling flecks and image analysis traits in *M.longissimus* muscle for Japanese Black cattle. Y. Nakahashi*[1], M. Oishi[1], Y. Hamasaki[1], S. Hidaka[1], S. Maruyama[2], and K. Kuchida[1], [1]*Obihiro University of Agricalture and Veterinary Medicine*, *Obihiro, Japan*, [2]*Gifu Prefectual Livestock Reseach Institute*, *Gifu, Japan*.

It is known that monounsaturated fatty acid (MUFA) ratios to total fatty acid are different among inter- and intra-muscular and subcutaneous fat even for the same animal. But there are few reports for the variation of the MUFA ratio by geometric change of marbling. Our objective was to investigate the variation of the MUFA ratio by the geometric and sectional change of marbling in rib eye. *M.longissimus* muscle of 8 Japanese Black steers from a common sire and a common maternal grand sire were used. Three slices (one was from rib roast and the others were from sirloin) were used for each animal. For each slice, 5 marbling flecks were randomly sampled to obtain the MUFA ratio by gas chromatography. High quality digital images of all slices were taken by a mirror type camera for carcass cross section. The area and coordinates of each marbling fleck were calculated by image analysis. The marbling flecks were categorized by area (S:<0.4 cm^2, M:0.4~2cm^2, L:>2cm^2), coordinate (dorsal, ventral), and slice section (rib roast, cranial and caudal sirloin). ANOVA was performed using SAS software. The MUFA ratio was treated as a dependent variable, and the classification of the area, coordinate and slice section were treated as fixed effects. The fixed effects were significant for the MUFA ratio ($P<0.05$). Least square means of S, M and L for the area of marbling flecks were 56.8%, 58.4% and 60.2%, respectively. Those of dorsal, ventral, rib roast, cranial and caudal sirloin were 59.1%, 57.8%, 55.4%, 59.9%, and 60.1%, respectively. Large marbling flecks revealed higher MUFA ratios ($P<0.05$). The MUFA ratio of the marbling flecks located in the rib eye of the dorsal part was higher than in the ventral part ($P<0.05$). Those from sirloin were higher than from rib roast ($P<0.01$). Interaction between slice section and coordinate was significant ($P<0.05$). MUFA ratios of marbling flecks located in the ventral part were higher than those in the rib roast of the dorsal part, but lower in sirloin.

Key Words: Japanese Black, MUFA Ratio, Image Analysis

T47 Effect of Zilpaterol or Ractopamine on productive performance of finishing bullocks. G. Aranda-Osorio*, R. Aguayo-Garcia, A. Carreño-Aviles, and J. C. Garcia-Ortiz, *Universidad Autonoma Chapingo*, *Chapingo, Mexico*.

The objective of this study was to evaluate the effect of adding β-agonists, Zilpaterol or Ractopamine, to the finishing diets of bullocks on: feed intake (DMI), average daily gain (ADG), and feed conversion (FC), under feedlot conditions. This investigation was carried out at the Experimental Farm of the Animal Husbandry Department of the University of Chapingo, Chapingo, Mexico. Thirty-six bullocks of commercial cross (Zebu x Brown Suiss) were used with initial liveweight of 427 ± 60 kg, which were housed in individual pens (2 × 2 m) and randomly allotted to the following treatments: T1, diet A without β-agonists; T2, diet A + zilpaterol; T3, diet A + ractopamine; T4, diet B without β-agonists; T5, diet B + zilpaterol; and T6, diet B + ractopamine; with 5 replicates per treatment. Diet A was elaborated using a true protein source (soybean meal) and the addition of a probiotic (Saccharomyces cerevisiae). In contrast, diet B was elaborated using poultry litter as a main source of protein and without probiotic. Both diets were formulated to meet the requirements of this type of cattle according to the NRC (1996). The experimental period lasted 92 d, and from d-60 to the end, β-agonists were added to the feed into the feedbunks and thoroughly mixed by hand for treatments 2, 3, 5 and 6. Feed was offered twice a day (0800 and 1600 h). Sixty mg of Zilpaterol hd^{-1} d^{-1} were supplemented to treatments 2 and 3; and 400 mg of Ractopamine hd^{-1} d^{-1} were supplemented to treatments 5 and 6, during the morning feeding only. Data were analyzed as completely randomized design using the GLM procedure of SAS. The comparison of Zilpaterol (T2 + T5) vs Ractopamine (T3 + T6) revealed no differences ($P>0.05$) in DMI (9.93 vs 9.59 kg hd^{-1} d^{-1}) or ADG (1.02 vs 1.08 kg hd^{-1} d^{-1}), although a difference ($P<0.05$) was found for FC (10.64 vs 9.29 kg d^{-1}). When β-agonists were added to diets A or B, animal performance tended ($P>0.05$) to improve, with no differences ($P>0.05$) between β-agonists. It is concluded that the β-agonists (Zilpaterol or Ractopamine) hardly represent an alternative to improve animal performance for beef producers using this type of diets and cattle.

Key Words: B-Agonists, Beef Cattle, Animal Performance

T48 Comparison of color value measured by colorimeter and image analysis method for beef muscle. Y. Hamasaki*[1], T. Saito[2], Y. Sato[2], S. Hidaka[1], and K. Kuchida[1], [1]*Obihiro University of A&VM*, *Obihiro, Hokkaido, Japan*, [2]*Hokkaido Animal Research Center*, *Sintoku, Hokkaido, Japan*.

Beef lean color is usually measured with a colorimeter. The marbling area percentage of Japanese Holstein steers is over 20%, so the diameter of the colorimeter (8mm) may be too large to measure the lean color accurately. The objective of this study were to compare the values from the colorimeter and from the high resolution digital image analysis as an accurate measurement of lean color of *M. longissimus thoracis* (ribeye) and to investigate whether the image analysis method is applicable to measure meat color. Digital images of the 6-7th rib cross section from 80 Holsteins were photographed for the beef carcass cross section. The ratio of marbling area to ribeye area (FATPER) was obtained by image analysis. Also, RGB components and luminance for lean, marbling and whole ribeye were calculated by the image analysis method. The L* value of lean was measured using the colorimeter (Minolta CR-13:Φ8mm) during the same time of photographing of the digital images. The L* values were measured 3 times per carcass then averaged. A multiple regression analysis was performed by REG procedure in SAS to predict the L* value by colorimeter. The L* value was used as a dependent variable, and traits obtained by the image

analysis were used as candidates of independent variables. Correlation coefficients between BCS (Beef Color Standard) numbers evaluated by graders and L*, and between BCS and luminance by the image analysis were -0.39 and -0.62, respectively. FATPER of ribeye was classified into 3 levels (S:<19%, M:19%~23% and L:>23%). Correlation coefficients of L* value and luminance of lean were 0.80 for S, 0.50 for M and 0.20 for L. The L* value of lean with a low FATPER level might reflect the accurate lean color. However, the L* value with more marbling meat might not be as accurate as the lean color value. In the multiple regression analysis predicting the L* value by colorimeter, the most affected image analysis traits for S, M and L were the luminance of lean, R component of whole ribeye, and G component of marbling, respectively. The diameter of the colorimeter probe might be oversized for measuring the lean color of beef, marbling included.

Key Words: Beef Color, Image Analysis, Colorimeter

T49 Alternative supplementation strategies for replacement beef heifers grazing dry California foothills annual range during summer. R. B. Monteiro*[1,2], G. D. Cruz[1], D. M. Myers[1], J. W. Oltjen[1], and R. D. Sainz[1], [1]*University of California*, *Davis*, [2]*University of Sao Paulo*, *Piracicaba, SP, Brazil*.

California's annual foothill rangelands are the main forage source for the state's range livestock industry and are characterized by marked seasonal variations in forage availability and quality. Due to the inadequate quality of dry forage during summer and fall, cattle require supplemental feed to balance deficiencies in protein, energy and minerals. The objectives of this study were to evaluate the effects of different types of supplementation for weaned heifer grazed in dry range and analyze the cost-benefit within the treatments. The supplements were: a commercial molasses-based tub supplement (COM; 30% CP) and a low-cost protein/energy/mineral formulation (UCD; 58% CP, 60% TDN, 3% P, 500 mg/kg Cu, 3 mg/kg Se). In 2005 and 2006, 60 weaned replacement Angus-Hereford heifers (248 ± 11.8 kg BW) were stratified by BW and allocated randomly to 6 groups of two supplement types with three replicate groups of 10 heifers for each treatment in each year. Heifers were given supplements every 3 d (UCD) or every 20 d (COM) for 70 d, and weighed every 28 d. Average daily gains were determined by regression. The data were analyzed by ANOVA with year and supplement as main effects and pasture group as the experimental unit. Supplement intakes were different ($P < 0.05$) between years, but ADG only tended to differ ($P < 0.10$). Across years, supplement intakes and costs per heifer averaged 547 and 398 g/d and \$0.331 and \$0.184 ($P < 0.05$) for the COM and UCD groups, respectively. Heifers' ADG were 78 and 246 g/d for the COM and UCD groups, respectively ($P < 0.01$). The UCD supplement produced greater gains (>3X) compared with a commercial tub supplement, at much lower cost. With appropriate feeders the UCD supplement can be fed free choice to improve calf performance and reduce costs of production.

Key Words: Beef Heifers, Annual Range, Supplementation

T50 Effects of deworming nursing calves 90 days prior to weaning on calf weaning weight. J. E. Rossi*[1], D. T. Ensley[2], and B. G. Mullinix, Jr.[1], [1]*University of Georgia*, *Tifton*, [2]*University of Georgia*, *Athens*.

Two trials were conducted to determine the effects of deworming winter born (Jan/Feb) calves 90 days (June) prior to weaning on calf weaning weight. In trial 1, nursing Angus calves (n=117, 174 ± 5.3 kg) were allotted by weight and sex in each of six fescue pastures. Treatments consisted of no deworming (CON) or deworming (DW) with Doramectin injectable (1 mL/50 kg BW). Equal numbers of steers and heifers were in each treatment within each pasture. All cows were dewormed with Doramectin pour-on (1 mL/10 kg BW) on d 0. Calves were weighed on d 0, 30, 60, and 90 of the trial. Data were analyzed using the MIXED procedure of SAS. Overall ADG was greater ($P < 0.10$) for DW (0.87 kg/d) compared with CON (0.84 kg/d) calves. Daily gain was not different ($P > 0.18$) from d 0 to 30 (1.03 and 1.00 kg/d for DW and CON; respectively), d 31 to 60 (0.95 and 0.91 kg/d for DW and CON; respectively) or d 61 to 90 (0.68 and 0.66 kg/d for DW and CON; respectively). In trial 2, nursing Angus, Angus × Charolais, and Hereford × Charolais calves (n=209, 175 ± 9.7 kg) were dewormed 90 days prior to weaning. Calves were allotted by weight, sex, and breed to each of three bermudagrass pastures. Treatments consisted of no deworming (CON) or deworming (DW). Equal numbers of steers and heifers were in each treatment within each pasture. Deworming and weighing procedures were the same as in Trial 1. Overall ADG was not different ($P = 0.59$) between treatments (0.95 and 0.93 kg/d for DW and CON; respectively). Daily gain was not different ($P > 0.32$) from d 0 to 30 (0.99 and 0.97 kg/d for DW and CON; respectively), d 31 to 60 (0.85 and 0.80 kg/d for DW and CON; respectively) or d 61 to 90 (0.99 and 1.00 kg/d for DW and CON; respectively). Calves that were dewormed returned \$5.15 per hd in Trial 1 and \$2.77 per hd in Trial 2 more than the CON calves when valued at \$1.00 per 0.45 kg of BW at weaning. Cost of the dewormer would be approximately \$1.60 per calf, excluding the cost of labor. Deworming nursing calves in early June (90 days prior to weaning) increased calf weaning weight in Trial 1 and increased the value of the calf at weaning in both trials.

Key Words: Calves, Deworming

Breeding and Genetics - Livestock and Poultry

T51 Joint analysis of egg and production traits in broilers. R. L. Sapp[1], T. Wing[2], and R. Rekaya*[3], [1]*USDA-ARS*, *Miles City, MT*, [2]*Cobb-Vantress, Inc.*, *Siloam Springs, AR*, [3]*University of Georgia*, *Athens*.

The objective of the study was to investigate the relationship between egg and production traits in chickens. The data were obtained from a closed, fully pedigreed, commercial broiler line. Records included measurements of body weight (BW), residual feed intake (RFI), percent breast meat (PBM), egg production (EP) and egg weight (EW) from 13,836 birds. A total of five analyses were conducted: 1) joint analysis of BW, RFI, PBM, EP, and EW in parent data (PA); 2) joint analysis of BW, RFI, and PBM in progeny data (PR1); 3) PR1 with EP and EW covariates (PR2); 4) PR1 with covariates of EP and EW grouped into 6 classes; and 5) joint analysis of BW, RFI, PBM, EP, and EW in both progeny and parent data (PR4). The mixed model included

fixed effects of contemporary group (flock-week of hatch-parent's flock) and sex; and random additive effects of bird, maternal effects of hen, maternal permanent environment and residual. For PA and PR4, random effect of permanent environment was also included in the analysis. The structure of the data was such that if birds had RFI, then they would not have PBM and vice versa. Heritability estimates obtained from PA for BW, PBM, RFI, EP, EW, and maternal BW were 0.16, 0.53, 0.26, 0.22, 0.47, and 0.16. For progeny data, heritability estimates of PBM and RFI were consistent across PR1 — PR4. In contrast, estimates for BW and maternal BW varied across PR1 — PR4 with PR2 and PR3 having higher estimates. Heritability estimates of the six traits using PR4 were similar to those obtained from PA. However, BW estimates obtained from PR2 and PR3 were significantly different from the estimates obtained using PA; thus indicating that methods including EP and EW as covariates overestimated BW heritability. Genetic and residual correlations ranged in magnitude and direction depending on the type of analysis. In conclusion, heritability estimates for the egg and production traits suggest that genetic improvement could be made. However, the relationship between these traits varies with the type of data and method used in the analysis. The fluctuation in these relationships could be due to the large number of missing records for PBM and RFI.

Key Words: Breast Meat, Egg Weight, Feed Conversion

T52 Cow/calf pre-weaning efficiency of Nellore, British × Nellore and Continental × Nellore crosses[1]. Liana Calegare*[1], Maurício Mello de Alencar[2], Irineu Umberto Packer[1], and Dante Pazzanese Duarte Lanna[1], [1]*ESALQ*, *Piracicaba, SP, Brazil*, [2]*Embrapa*, *Sao Carlos, SP, Brazil*.

In Brazil, purebred Nellore and its crosses represent around 75% of the total beef cattle herd. Crossbreeding programs have introduced different breed types with higher growth potential. However, knowledge of nutritional requirements and biological efficiency is vital to match maternal breed types to the environment. The objective of this study was to determine cow/calf efficiency. Data from fifty-eight cows from three breed types Nellore (NL), Angus × Nellore (AN), and Simmental × Nellore (SN) were used. Cows were randomized in blocks by calving date during two separate years (2002 and 2006). Crossbred cows were bred to Canchim (5/8 Charolais) bulls and NL cows to Nellore bulls. Cows and respective calves were individually fed from postpartum to weaning (20-190 d). The estimated ME and CP content of the diet were 2.2 Mcal and 16% CP for 2002 and 1.9 Mcal and 12% CP/kg DM for 2006. Calves received the same diet of their dams *ad libitum* beginning at 35 d of age. Milk yield was estimated by weighting calves before and after suckling. ME intakes by cow/calf pairs were different ($P<0.01$); 4212±66.9 for SN, 3895±67.3 for AN and 3433±70.7 Mcal for NL. The energy intake was parallel to milk yield and calf's growth rate. At birth the ¼S calves were heavier ($P<0.05$; 43.2±1.4) than ¼A (38.8±1.4) and Nellore (32.5±1.5 kg). This group had lower BW at weaning ($P<0.01$; 171±7.2) than ¼A (231±6.9) and ¼S calves (241±6.8 kg). NL pairs had lower ($P<0.05$) cow/calf efficiency (grams of calf BW gain/Mcal of MEI by cow/calf pair); 40.9±1.6 vs. 47.4±1.5 for SN and 49.5±1.6 g/Mcal for AN. The lower efficiency of purebred Nellore is confounded by the fact that there is no heterosis in this group. The higher MEI by crossbred pairs was more than compensated by the higher BW gain. There was high individual variability of efficiency (between and within-breed). Crossbred cows had 15% greater energy requirements than Nellore cows and may not be adapted to certain environments.

Key Words: Biological Efficiency, Breed Type, Weaning Weight

T53 Morphologic evaluation of Murrah water buffalo through regression and principal component analysis. J. R. B. Sereno*[1], M. V. Snel-Oliveira[2], S. M. Vasconcelos[2], A. A. Egito[3], M. S. M. Albuquerque[3], C. McManus[4], and J. C. Souza[5,6], [1]*Embrapa Cerrados*, *Planaltina, DF Brazil*, [2]*UPIS-Faculdades Integradas*, *Brasilia, DF Brazil*, [3]*Embrapa Recursos Geneticos e Biotecnologia*, *Brasilia, DF Brazil*, [4]*Universidade de Brasilia*, *Brasilia, DF Brazil*, [5]*Universidade Federal do Parana*, *Campus Palotina, PR Brazil*, [6]*University of Missouri-Columbia Scholarship of CNPq, Brazil*, *Columbia, Mo USA*.

This study aimed to analyze morphometric data of the Murrah water buffalo using principal component and regression analysis. Traits included ear length and width, horn length and width, back diameter, head length and width, body length, hip height, thoracic and cannon bone perimeter, height and length of croup, distances observed between pelvic bones, width of haunches, head profile and body score. Two hundred and twenty seven females were used, divided in four categories (suckling, weaned, intermediate and adults). These were measured using a tape measure and a measuring stick. The first two principal components explained 78% of all variation between traits. Correlations between traits were in general high (>0.60), except for diameter at the ribs. The first component showed that as a one trait increased in size the other traits also increased in size, as expected. The second component separated the animals into those that were long and thin from those that were short and stocky. Two different groupings were observed, those represented by suckling and weaned heifers and another by intermediate and adult cows. Within group variation for the traits was low (CV<10%). Among the traits analyzed those related to head conformation were the most heterogeneous. The regression analysis showed that these animals increase in size up to 80 months of age, when there is a tendency for a plateau. These data serve as a basis for comparison with a larger number of animals, with the objective of confirming these tendencies for the Murrah breed.

Key Words: Management, Phenotypical Evaluation, Animal Breeding

T54 Genetic parameters for weaning weight by age of dam for Brazilian Nellore. L. O. Campos da Silva*[1], J. C. Souza[2,3], A. Gondo[3], C. H. M. Malhado[4], J. A. Freitas[2], I. W. Santos[2], J. R. B. Sereno[6], R. Weaber[8], L. D. Van Vleck[7], and W. R. Lamberson[8], [1]*Embrapa-GNPGC*, *Brazil*, [2]*Scholarship of CNPq*, *Brazil*, [3]*Parana Federal Univeristy*, *Palotina, PR Brazil*, [4]*Bahia State University*, *Brazil*, [5]*Mato Grosso do Sul Federal University*, *Brazil*, [6]*Embrapa-CPAC*, *Brazil*, [7]*University of Nebraska*, *Lincoln*, [8]*Univeristy of Missouri*, *Columbia*.

The objective was to estimate genetic parameters by age of dam subclass for weaning weight of Nellore cattle raised on pasture in two regions of São Paulo State, Brazil, between 1975 at 2001. The data were from ABCZ / EMBRAPA and included 51,664 weights at 205

d (W205) from progeny of 24,996 cows. Records were grouped on the basis of age and number of calves of dams. Seven groups were established: G1 included all dams; G2 had dams with a minimum of 2 calvings, age of first calving greater than 60 mo, and calving between 280 and 1095 d; G3 had dams with one parturition (first) between 22 and 84 mo; G4 to G7 included dams calving between 35 and 60; 61 and 84; 85 and 120; 121 and 240 mo of age, respectively and all had at least two parturitions with no restriction for calving interval. Estimates of variances and covariates were obtained from single trait analyses using the MTDFREML set of programs. Fixed effects were contemporary group [season (dry or wet), year, sex and farm combination] with age of dam as linear and quadratic covariates. Random effects were direct and maternal genetic effects with covariance, and the uncorrelated maternal permanent environmental effect. Estimates of direct heritabilities ranged from 0.14 ± .02 to 0.19 ± 0.02 for all groups except G5 which had an estimate of 0.26 ± 0.06. Maternal heritabilities ranged from 0.02 ± 0.09 to 0.11 ± 0.11. Estimates of the direct-maternal genetic correlation were negative and increased from -0.14 ±.66 for G4 to -0.87± 0.20 for G6, although the estimate was near zero with a large standard error for G7. These results suggest that heritabilities remain relatively constant across age of dam groups for Nellore, but that the direct-maternal genetic correlation may become more negative for older dams.

Key Words: Age of Dam, Heritability, Weaning Weight

T55 Dairy cattle mortality trends in southeastern states. G. W. Rogers*[1], J. B. Cooper[1], and J. S. Clay[2], [1]*University of Tennessee*, *Knoxville*, [2]*Dairy Records Management Systems*, *Raleigh, NC*.

Lactation records from dairy herds in 9 Southeastern states processed through the Dairy Records Management Systems were utilized to determine rates of dairy cow mortality between 1982 and 2005. Over 1.1 million cows in 2038 herds born on or after January 1, 1980 were used for calculating the frequency for died code (termination code of 6) by calving year, lactation number and breed (Holstein or Jersey). Herds were required to have 10 or more years of continuously collected Dairy Herd Improvement data and 5 or more first calvings per year. These edits resulted in 1768 Holstein herds and 270 Jersey herds averaging over 1500 calvings. The percentage of cows that died during first lactation increased from the early 1980s to early 2000s; Jersey death losses in first lactaton increased from 1.4% to 2.6% and Holstein death losses in first lactation increased from 1.7% to 4%. Actual mortality rates in this age group may be higher as cows that calve and die before their first test date often are not included in records. Frequencies for mortality in lactation 2 and lactations 3 or greater are conditional on survival during the previous lactation. The percentage of cows that died during second lactation also increased from the early 1980s to early 2000s; Jersey death losses in second lactation increased from 2.2% to 4% and Holstein death losses in second lactation increased from 2.3% to 5.7%. The percentage of cows that died in third and later lactations increased from the mid 1980s to early 2000s; Jersey death losses in this group increased from 4.4% to 9% and Holstein death losses increased from 3.8% to 10.1%. Average death losses in the 24-year period for Jersey herds was less than that for the Holstein herds: 4.4% versus 4.8% for all lactations, 1.9% versus 2.9% for first lactations, 3.0% versus 3.8% for second lactations and 7.0% versus 7.2% for lactations 3 or greater. Cow mortality has increased approximately 2.5 fold over the past 2 decades in Southeastern dairy herds.

Key Words: Dairy Cow Mortality, Death Losses, Southeastern US

T56 Weaning weight and wool traits in a grade-up program of Rambouillet sheep with Australian Merino genetics. W. M. Rauw*[1], H. A. Glimp[1], T. Wuliji[1], M. Teglas[1], W. Jesko[2], and L. Gomez-Raya[1], [1]*University of Nevada*, *Reno*, [2]*Rafter 7 Ranch*, *Yerington, NV*.

The aim of the present study was to evaluate the influence of inclusion of Merino genetics on weaning weight (WW), greasy fleece weight (FW), staple length (SL) and fiber diameter (FD) and to calculate heritabilities, and phenotypic (rp) and genetic correlations (rg) for the wool traits. Records were available on 4408 to 9597 animals between 1992 and 2005. The Rafter 7 flock was initiated in Nevada in 1990 with the purchase of 500 purebred Rambouillet (R) ewes. A grade-up program (1/2, 3/4, 7/8, purebred) was initiated using Australian Merino semen (M) with the aim of developing a purebred Merino flock. The Rafter 7 line (approximately 5/8 M and 3/8 R), was created in 1999 and has been a closed line since. The percentage of M in the flock increased during this time interval. Least squares means of WW were estimated from a model that included the effects of sex, breed, year of birth, birth-rearing type, age of the dam and age at weaning. Least squares means of wool traits were analyzed with the same model but including age at shearing instead. Phenotypic correlations were estimated after adjustments were made for the traits included in the model. Heritabilities and genetic correlations were estimated with a multi-trait animal model. Heritabilities were 0.20 for SL (± 0.018), 0.39 for FD (± 0.013), and 0.27 for FW (± 0.019). Animals with higher SL had higher FD (rp = 0.22, $P<0.0001$; rg = 0.26 ± 0.053) and higher FW (rp = 0.31, $P<0.0001$; rg = 0.52 ± 0.055). Animals with higher FD had higher FW (rp = 0.32, $P<0.0001$; rg = 0.38 ± 0.042). Results indicate that in general, within year of birth, the inclusion of Merino genetics resulted in decreased WW ($P<0.05$), increased FW ($P<0.05$), and decreased FD ($P<0.05$). Clear effects on SL were not apparent. This indicates that the grade-up program had a somewhat negative effect on WW, but resulted in improved wool quantity and quality.

Key Words: Merino Sheep, Weaning Weight, Wool Traits

T57 An evaluation of SNP associations with calpastatin enzyme activity and shear force measures in Brahman steers. D. E. Franke*[1], M. G. Thomas[2], A. J. Garrett[2], and T. D. Bidner[1], [1]*Louisiana State University Agricultural Center*, *Baton Rouge*, [2]*New Mexico State University*, *Las Cruces*.

Objectives were to associate SNPs in the GeneSTAR tenderness panel of genetic markers (www.bovigen.com) with calpastatin (CAST) enzyme level and Warner-Bratzler shear force of steaks aged for 7 (SF7) and 14 (SF14) d from purebred Brahman steers (n=382). Steers were fed postweaning and harvested when they reached 10 to 15 mm fat thickness and acceptable market weight. Samples of DNA were collected from each steer prior to slaughter. Genotypic frequencies at a CAST locus in the 3′ untranslated region were 0.107 for C/C, 0.469 for C/T, and 0.424 for T/T nucleotides, respectively. Allelic frequencies were 0.342 for C and 0.658 for T nucleotides. Genotypic frequencies

at the calpain (CALP316) locus were 0.063 for C/G and 0.937 for G/G nucleotides, resulting in allelic frequencies of 0.031 and 0.969 for C and G, respectively. Similarly, genotypic frequencies at the CALP4751 locus were 0.099 and 0.901 for C/T and T/T nucleotides, respectively. Allelic frequencies were 0.050 and 0.950, respectively, for C and T nucleotides. No C/C nucleotide pairings at the CALP316 locus or C/C nucleotide pairings at the CALP4751 locus were observed. Genetic markers at the CAST locus significantly influenced variation in calpastatin enzyme activity but not in SF7 or SF14. Regression of calpastatin enzyme activity on number of favorable marker alleles at the CAST locus was -0.343 ± 0.071 ($P \leq 0.01$). Genetic markers at the CALP316 or the CALP4751 locus did not influence variation in shear force. However, regression on combinations of CALP316 and CALP4751 favorable markers predicted variation in SF7 (-.226 ± 0.110) and SF14 (-0.240 ± 0.091), respectively. Eight haplotypes were identified among the three loci with C-G-T and T-G-T having the highest frequencies at 0.314 and 0.606, respectively. Haplotype T-G-C had a frequency of 0.032 and all other haplotypes had frequencies less than 0.02. Results suggest that combinations of SNP genetic markers in the GeneSTAR tenderness panel will significantly reduce SF7 and SF14 in Brahman steers. Most importantly, a SNP within CAST influenced the activity of this protein.

Key Words: Brahman, Genetic Markers, Shear Force

T58 Gene polymorphisms associated with mastitis and reproduction traits in Holstein cows. G. M. Pighetti*, C. J. Kojima, and A. M. Saxton, *University of Tennessee*, *Knoxville*.

Genetically identifying cattle less susceptible to mastitis and more fertile will be a key factor in producing healthier cattle populations. Because mastitis and fertility are influenced by a variety of factors, several markers most likely will be needed to identify an animals genetic potential. As a step towards this goal, we evaluated the association of a series of single nucleotide polymorphisms (SNP) in two immune related genes (CXCR1 and NRAMP1) on BTA2 with mastitis and reproductive traits in 96 Holstein cows. Of the >40 SNP identified, 5 were chosen that best represented the genetic variation in that region of BTA2. Of the SNP evaluated, 3 were associated ($P<0.10$) with disease and/or reproductive traits, 4-226 and 5-577 in CXCR1 and K1-245 in NRAMP1. The 4-226 SNP tended to be associated ($P<0.10$) with clinical mastitis, subclinical mastitis, and days open. In our sample population, cows with an AA or AG genotype were twice as likely to develop subclinical and clinical mastitis as cows with the GG genotype. Interestingly, the AA genotype tended to have fewer days open then the other two genotypes. A second SNP in CXCR1, 5-577, introduces an early stop codon in the receptor which has a strong potential to influence immune function. This SNP tended to be associated with subclinical mastitis. The NRAMP SNP was significantly associated ($P<0.05$) with clinical mastitis: heterozygous cows experienced twice as many infections as cows homozygous for the C allele. No significant associations with were observed with somatic cell score, however this may be related to low SCS observed in the herd (<3.0). Nor were any significant associations observed with days to first service. Based upon these findings and our prior research indicating a significant association between mastitis and immune function with another SNP in the CXCR1 gene, we believe this region of BTA2 is a relevant mastitis resistance locus and potentially reproductive trait locus. To further define a desirable genetic background, the next step is to evaluate these 3-5 SNP in a larger, well-defined Holstein population.

Key Words: Marker, Mastitis, Reproduction

T59 The genomic architecture of a major QTL region on chicken chromosome 4: CpG islands, gene density and repetitive elements. G. A. Ankra-Badu and S. E. Aggrey*, *University of Georgia*, *Athens*.

This study was conducted to characterize the genomic landscape of a major QTL region and to identify novel candidate genes by CpG island detection and comparative mapping. One hundred and nine genes and 179 CpG islands were detected at this locus and thirty four percent of these genes contained CpG islands. The region spanning 68-70 Mb had the highest CpG island density and the second highest number of genes. Analysis of the distribution of repetitive elements showed that LINE, low complexity and simple repeats constituted the majority of repetitive DNA in the QTL region. Generally regions with a high GC content and gene and CpG island density had a relatively low percentage of repeats. Seventy three genes from a match with twenty species which are involved in protein synthesis, transcriptional regulation and other functions were identified by comparative mapping. Six probable novel genes were identified on GGA4 by blasting a selection of these genes against the chicken genome. Three of these genes are housekeeping genes which are either involved in protein transport or signal transduction. A putative ortholog of rhotekin, which is a housekeeping gene with nucleotide binding and apoptosis functions, was detected in the region orthologous to the Fugu (puffer fish).

Key Words: QTL Region, CpG Islands, Repetitive Elements

T60 Modeling social competition assuming a single dominant animal per pen. J. M. Achi*, I. Misztal, and R. Rekaya, *University of Georgia*, *Athens*.

The model of social competition by Muir and Schinckel (MS) assumes continuous expression of social dominance. The purpose of this study was to examine a model where such an expression is binary. The simulated data set included 18,000 animals across three generations. A pen effect was included with six animals per class. Two additive values were assigned per animal, direct and social dominance; both effects were assumed correlated. Liability of social dominance was calculated as a sum of the social dominance effect plus a residual term. For each pen, the animal with the highest liability was declared dominant. The simulated growth phenotype was calculated as a sum of effects of pen, generation, direct, dominance advantage, and the residual. The effect of dominance advantage was only present in records of dominant animals. It was fixed to a constant value in model 1 (M1) or equal to the effect of social dominance in model 2 (M2). A bivariate linear-threshold was used for analysis where the second trait was the dominance status assumed known. Initial analyses assumed M1. When the second trait was ignored, the estimate of the dominance advantage was unbiased when the covariance was 0, was biased upwards when the covariance was positive, and downwards if negative. There was no bias when the second trait was considered in the analysis.

Variance components were estimated for a scenario with a positive correlation. There was an upward bias for the direct variance and downward for the competitive variance and the covariance. The biases were traced in part to the fixed threshold used for all records. A variable threshold is required so that exactly one animal per pen is selected as dominant. Variance components were estimated and animal effects predicted with the MS model. The correlations between the competitive effects from the two models were close to 0. When M2 was used, the same correlation was -0.1. It seems that modeling social dominance with different models may result in drastically different rankings.

Key Words: Social Dominance, Competitive Effects, Simulation

T61 Obtaining multiple QTL solutions without inverting the IBD matrix. M. Jafarikia*, J. A. B. Robinson, and L. R. Schaeffer, *University of Guelph*, *Guelph, Ontario, Canada*.

The inverse of an Identity By Descent (IBD) probability matrix is required for most Quantitative Trait Loci (QTL) studies. Although different methods are available for the calculation of an IBD matrix, direct inversion of that matrix can be computationally very demanding for large data sets. In order to obtain the QTL solutions without inversion, an average gametic relationship IBD matrix was used so polygenic and QTL incidence matrices were equal. A subset of the mixed model equations consisting of fixed and polygenic effects was created and after obtaining the solutions for this subset, the following formula was used to obtain the QTL solutions: $\hat{\mathbf{u}}_n=(\sigma_{un}^2\mathbf{G}_n\mathbf{A}^{-1}\hat{\mathbf{a}})/\sigma_a^2$ where $\hat{\mathbf{u}}_n$ is the vector of solutions for qtl n and σ_{un}^2 is the variance of QTL n and $\mathbf{G}_n$ is the IBD matrix of haplotype n, $\mathbf{A}^{-1}$ is the inverse of additive relationship matrix, $\hat{\mathbf{a}}$ is the vector of polygenic solutions and σ_a^2 is the additive genetic variance. Using an iteration procedure, the predicted QTLs effects were subtracted from observations and the fixed/polygenic subset of equations were re-solved with the adjusted observations. Then the QTL effects were solved as above and the cycle repeated until convergence was reached. The proposed methodology was applied to a simulated chromosome with 20 markers and four QTLs located in the middle of four haplotypes. The number of markers on each haplotype was four, ten, two and four respectively. A half-sib population with five grand sires, 50 sons per grandsire and 50 daughters per son was simulated. The model included fixed contemporary groups, random polygenic, QTL and residual terms with variances of 22.08% for polygenic, 1.92%, 1.92%, 4.48%, 9.6% for the four QTLs and 60% for the residual. The example converged after 39 iterations and there were no significant differences between the solutions of the full equations and proposed shortcut method. Both the Pearson and Spearman rank correlations were 1.00.

Key Words: IBD, QTL, Inverse

T62 A Microsatellite Repeat Search (MRS) tool for eukaryotic genomes. L. Klein*[1,2], S. Puri[1,2], G. Blachut[3], and E. Smith[1], [1]*Virginia Polytechnic Institute and State University*, *Blacksburg*, [2]*Blacksburg High School*, *Blacksburg, VA*, [3]*Hinsdale South High School*, *Hinsdale, IL*.

There continues to be significant interest in microsatellites because of their implication in neurological diseases and their utility as DNA markers for common disorders. Their distribution in the genomes of model, human and agriculturally important species therefore remains of interest to scientists. Previous studies, supported by annotation results of the recently released chicken genomic DNA sequence, suggest that microchromsomes have a higher gene density and by inference lower repetitive sequences than macrochromosomes. Here, we developed a bioinformatics tool, Microsatellite Repeat Searcher (MRS), that was used to evaluate the relative distribution of microsatellites on micro- and macrochrosmosomes in the chicken, Gallus gallus. A total of 9,138 repetitive elements were identified within a total of 1,133,629,576 bp of sequence scanned. Though inconsistent, an inverse correlation was observed between chromosomal length and microsatellite frequency. The tool described here should be useful for searching whole genomes of other vertebrates for repetitive elements. Our data appears to support the hypothesis that the gene-rich microchromosomes also have a lower percentage of repetitive elements.

Key Words: Microsatellites, Bioinformatics Tool, Chicken

T63 Analysis of protein in pig blood serum at growing stages. H. Y. Chung*, S. H. Yoon, B. H. Choi, K. T. Lee, and G. W. Jang, *National Livestock Research Institute*, *Suwon, KY, Korea*.

The purpose of this study was to detect differentially expressed proteins in pig blood serum at growing stages, which were constructed with birth, 6, 12, 18, 24 and 30 weeks of age. A total of 16 spots from 2D gels were observed for differential expression at each growing stage. Mass spectrometric (MS/MS) analysis of the spots identified Ig kappa light chain, Ig lambda chain C, haptoglobin alpha 1S, gamma fibrinogen, Ig gamma 1 chain, Retinol-Binding Protein, albumin, apolipoprotein A-IV, antithrombin protein, alpha-1-antitrypsin and fibrinogen A-alpha-chain. Most of the proteins were gradually expressed from birth to 30 weeks, but a few proteins were not expressed at birth. SNPs from the identified loci were genotyped across 300 pigs from a commercial population. Three loci for the Ig lambda chain C and haptoglobin alpha 1S gene were significantly associated with birth and weaning weights ($P<0.01$). Therefore, genes identified in this study may account for some of the genetic variation and differential protein expression in animal growth.

Key Words: Growing Stages, 2D Analysis, Polymorphism

T64 Construction of SNP maps in the region of the swine SLA class I for miniature pig. H. Y. Chung*, S. H. Yoon, B. H. Choi, K. T. Lee, and G. W. Jang, *National Livestock Research Institute*, *Suwon, KY, Korea*.

In order to construct SNP maps focusing on the swine leukocyte antigen region, the SLA class I region was screened by PCR using miniature pig BAC clones. The swine leukocyte antigen (SLA) class I region containing MHC class Ia, Ib, related genes, and pseudogenes, was analyzed to provide genetic information for transplantation research in pig. A total of 990 primers were designed and covered 1,500,000 bp locating on pig chromosome 7q11-16. Miniature pigs were used to infer haplotypes and SNP maps, with a total of 4,000 SNPs discovered. The sequence information from miniature pigs was compared with 5 pig breeds (Landrace, Hampshire, Yorkshire, Duroc,

and Berkshire). The SNPs discovered in this study may provide useful genetic information for organ transplantation research.

Key Words: SNP, Swine Leukocyte Antigen (SLA), Haplotype

T65 Impact of inbreeding on IBD probabilities and estimates of QTL variance. G. Freyer[2] and N. Vukasinovic*[1], [1]*Monsanto Animal Genomics and Breeding*, *Saint Louis, MO*, [2]*Research Institute for the Biology of Farm Animals (FBN)*, *Dummerstorf, Germany*.

QTL mapping in complex pedigrees using a variance component approach has become popular as increasing numbers of animals are routinely genotyped in dairy populations. In this approach, the QTL effect is modeled as a function of the probabilities that two alleles in the same or in different animals at a particular position in the genome are identical by descent (IBD probabilities). Proper calculation of IBD probabilities and therefore, modeling and estimation of QTL variances depend on many factors such as the number of markers, their information content, and the level of relatedness of the animals in the pedigree. In this simulation study, we investigated how the level of inbreeding, coupled with varying marker information content, influenced IBD probabilities and the estimates of QTL variances. Four multi-generational pedigrees with 850 individuals each were simulated. The final offspring of 9 sires originated from two founder (great-grand) sires. Four family structures (FS) with different levels of inbreeding were considered: FS0 was non-inbred; FS1 contained an inbred sire originating from an aunt-nephew mating; FS2 contained a 25% inbred sire, originating from a half-sib mating. FS4 in addition contained a grand sire originating from a father- daughter- mating, where one of the two resulting sires was mated to his dam to further increase the level of inbreeding. All animals were assumed genotyped for 11 unevenly spaced markers within a 55cM long putative QTL region, containing a QTL within the 7th marker bracket. The number of marker alleles was 2, 4, or 6. Complete marker information and 20% randomly missing marker genotypes were considered. IBD probabilities for each cM in the segment were calculated using the nearest informative marker bracket. Means and variances of IBD probabilities increased with both increasing level of inbreeding and increased marker information. Estimates of the QTL variances at the true QTL position obtained from data sets with 2 marker alleles and without missing genotypes were closest to the simulated values, regardless of the inbreeding level.

Key Words: Inbreeding, Pedigree, QTL

T66 Relationship of herd-heritability with sire misidentification and entry into a proven sire lineup. C. D. Dechow[1], H. D. Norman*[2], and N. R. Zwald[3], [1]*The Pennsylvania State University*, *University Park*, [2]*Animal Improvement Programs Laboratory*, *Beltsville, MD*, [3]*Alta Genetics, Inc.*, *Watertown, WI*.

The objectives of this study were to estimate the relationship of individual herd heritability with sire misidentification rate and the likelihood of a sire entering an active sire lineup after progeny testing. Milk, fat and protein yield and somatic cell score (SCS) were provided by the Animal Improvement Programs Laboratory at USDA. Paternity verification results from DNA marker analysis were provided by Alta Genetics, Inc. for 145 herds. The number of cows tested per herd ranged from 5 to 274. Herd heritability was calculated with daughter-dam regression and daughter-sire predicted transmitting ability (PTA) regression using 6,848,885 records from 17,608 herds. Herd heritabilities were estimated with regression models in AS-Reml that included fixed breed, age within parity, herd-year-season of calving, dam records nested within state, and sire PTA within state; random regression coefficients were dam records and sire PTA within herd. Average daughter-dam herd heritability estimates ranged from 0.26 (SCS) to 0.41 (fat yield), whereas daughter-sire herd heritability ranged from 0.11 for SCS to 0.20 for fat yield. Correlations between herd heritability and sire misidentification rate ranged from -0.23 to -0.43. The correlation between a principal component for all measures of herd heritability and sire misidentification rate was -0.45. Sires that were proven in low heritability herds were less likely to enter a proven sire lineup than sires proven in average to high heritability herds. Individual herd heritabilities can be generated with simple regression techniques for several thousand herds simultaneously. The herd heritability estimates could be used to identify herds that might provide inaccurate data for progeny testing, and could be used to identify sires with potentially underestimated genetic evaluations.

Key Words: Herd Heritability, Sire Misidentification, Daughter-Dam Regression

T67 Heritability estimates for producer recorded clinical mastitis events. C. D. Dechow[1], J. Vallimont*[1], C. G. Sattler[2], and J. S. Clay[3], [1]*The Pennsylvania State University*, *University Park*, [2]*Select Sires, Inc.*, *Plain City, OH*, [3]*Dairy Records Management System*, *Raleigh, NC*.

The objective of this study was to estimate heritability for producer-recorded clinical mastitis events. Cow health events were provided by Dairy Records Management Systems (Raleigh, NC) for progeny test herds that use PCDART. First through fifth lactation data from cows calving between 20 and 120 months of age and that calved in a herd-year with at least 1% of cows with a clinical mastitis event were retained. The edited dataset contained 105,527 records. Mastitis (1 = at least one mastitis event during lactation, 0 = no mastitis events) was analyzed with two single trait animal models in AS-Reml with fixed effects for age within parity and herd-year-season of calving; random effects were animal, permanent environment and error. Mastitis was treated as a linear response variable in the first analysis and as a binary response variable in the second analysis. The incidence of clinical mastitis was 14%. When data was restricted to herds with a minimum of 5% clinical mastitis, the average lactation incidence rate was 19%. Heritability estimates were 0.02 when mastitis was treated as a linear response variable and 0.15 when treated as a binary response variable. Repeatability estimates were 0.07 and 0.16 for the linear and binary response variables, respectively. The correlation between PTA from the linear and binary models was 0.98. Significant genetic variation exists for clinical mastitis and health events recorded by producers could be used to generate genetic evaluations for cow health. While heritability estimates varied between linear and binary models, sires ranked similarly for daughter mastitis susceptibility with both methods.

Key Words: Mastitis, Heritability, Repeatability

T68 Different UBX domain D Gene from subtraction cDNA isolated from Korean native chicken. S. S. Sun*, K. Kuk, and K. H. Myung, *Chonnam National University*, *Gwangju, Korea*.

The objectives of this study are to identify specific functional genes which related with growth and structure of pectoral muscle in Korean native chicken. Pectoral muscle was isolated from the Korean native chickens (KNC, red brown, 12 months old, 2.41kg±0.24) and Cornish chickens (16 month old, 2.76±3.04kg). The subtraction cDNA library was prepared in PCR4 Blunt-TOPO vector and the insert was sequenced. The DNA sequence homology was compared with other breeds and species in GenBank. A clone NDS-10 was unique for the DNA sequence homology with UBX family. NDS-10 has 612 nucleotides. This partial sequence has high homology (98%) with chicken UBX domain D. The expression of DNS-10 could change three-dimensional structure of skeletal muscle and could modify texture of breast muscle. Several regions were mutated from T in chicken to C or G in NDS-10. It may have severe structural modification due to not making H-bond between T and A. They are going to make G-C linkage for their three-dimensional structure. The late regions were point deleted and then can not be translated or expressed to different protein. Chicken UBX domain containing 4 (UBXD4) and mRNA for hypothetical protein from clone 10c14 ND were compared. They are 98% (571/579nt) homology of nucleotide sequence. Chicken UBX domain has chicken (93%), cattle (68%), dog (67%), and mouse (64%), human (63%) nucleotide sequence homology. We conclude that the clone NDS-10 could be a new candidate gene for UBX family gene.

Key Words: UBX Domain D, cDNA, Korean Native Chicken

T69 Efficiency of Brown Swiss, Holstein and their crosses estimated with data envelopment analysis. C. D. Dechow[1], M. I. Phelps*[1], S. Roth[1], G. W. Rogers[2], and J. B. Cooper[2], [1]*The Pennsylvania State University*, *University Park*, [2]*The University of Tennessee*, *Knoxville*.

The objective of this study was to compare the efficiency of Brown Swiss (BS), Holstein (HO) and crosses among BS and HO using data envelopment analysis (DEA). A multi-dimensional efficiency frontier that is derived from of the most efficient production units (cows) is generated by DEA. Cows that do not reside along the frontier must reduce inputs relative to their level of output to become efficient. The output variables were first lactation total milk, fat and protein yield obtained from six herds. Input variables were days in milk, age at calving, days open and estimated body weight. BS and HO were assumed to have equivalent body weights and heterosis for body weight was assumed to be 3%. The analysis was performed with the DEA Excel Solver for each herd individually. A solution was successfully attained for three herds totaling 334 cows of the following breed combinations: 184 HO, 89 BS, 27 first generation crosses (F1) and 34 backcrosses (F2). Resulting efficiency values were analyzed with the GLM procedure of SAS. Breed combination and herd-year-season of calving were independent factors and least squares means for efficiency were estimated for breed combination. Least squares means for efficiency were 0.79, 0.86, 0.91 and 0.83 for BS, HO, F1 and F2, respectively. The heterosis estimate for efficiency in the first generation of crossbreeding was 10.3%, and F1 were significantly more efficient than BS or HO. Relative to F1, BS were required to reduce all inputs and increase milk production to become more efficient. HO were generally required to reduce days open and increase fat and protein yield when compared to F1. To raise efficiency of F1 further, milk production needed to increase when compared to HO and protein yield needed to increase relative to BS. An efficiency value that does not require assumptions about the economic value of inputs or outputs can be obtained with DEA in order to compare cows of different breeds. However, more advanced software was required to handle large datasets. There was evidence that crossbreeding with BS increased the efficiency of production when compared to pure HO.

Key Words: Data Envelopment Analysis, Crossbreeding, Efficiency

T70 Estimation of genetic and phenotypic parameters for days open and test day milk yields in Japanese Holsteins. Y. Masuda*, H. Abe, and M. Suzuki, *Obihiro University of Agriculture & Veterinary Medicine*, *Obihiro, Japan*.

The objective of this study was to estimate genetic and phenotypic parameters for days open and test day milk yield in the first two lactations of Holstein cattle in Japan. Monthly test day yields and insemination data were provided by the Hokkaido Dairy Milk Recording and Testing Association. Cows with first test day yields recorded after 35 days in milk and with days open less than 22 d or greater than 300 d within lactation were excluded. The first five test day records for each cow were extracted and treated as a separate trait. All data were split along lactation numbers into two data sets; days open and test day records from 158,994 and 73,290 cows calving between 1990 and 2002 for first and second parities, respectively. (Co)variance components within lactation were estimated using a bivariate animal model and the AI-REML procedure. The model included herd-year of calving, age at calving and month-year of calving as fixed effects, and random animal and residual effects. Heritability estimates for days open were 3.0% and 2.6% for first and second parities, respectively. Genetic correlations between days open and 1st to 5th test day milk yields were 0.42, 0.48, 0.52, 0.54 and 0.48 (0.27, 0.36, 0.34, 0.38 and 0.30) for the first (second) lactation, respectively. These results indicate that genetically high milk production during early lactation may lead to increase days open especially in first parity. Phenotypic correlations between days open and test day yield ranged from 0.04 to 0.07 and 0.03 to 0.05 for first and second parities, respectively. In another analysis, averages and standard deviations for days open decreased as the production level of the herd increased. Although there is an undesirable genetic relationship between days open and milk yields in early lactation, phenotypic correlation is close to zero due to an effort to improve reproductive efficiency in the individual herd.

Key Words: Days Open, Test Day Milk Yield, Genetic and Phenotypic Correlations

T71 Residual feed intake and temperament breed differences among Florida heifers. D. G. Riley*[1], G. R. Hansen[2], S. W. Coleman[1], and C. C. Chase[1], [1]*USDA, ARS*, *Brooksville, FL*, [2]*University of Florida*, *Marianna*.

The objective of this work was to evaluate residual feed intake, average daily gain, chute temperament score, and exit velocity of Brahman (B), Angus (A), and Romosinuano (R) (n = 40, 19, and 26, respectively)

and F_1 (n = 7, 8, and 12 for BA, RA, and RB, respectively) heifers. One month after weaning in September 2006, heifers were transported 485 km to the Florida panhandle. Heifers were placed in feeding pens and acclimated to a corn-based diet for 3 wk. Subsequently, they completed a 70-d intake test. Body weight, chute temperament score (from 1 to 5; higher scores indicated more nervous behavior), and exit velocity (m/s) were recorded weekly. Body weight and feed consumption records were used to generate residual feed intake values (RFI). Average daily gain and feed conversion ratio (FCR) were calculated. Pen (n = 6), breed (n = 6; 3 purebred and 3 crossbred groups), and age of dam were fixed effects. Age in days at test start was included as a covariate. Body weight was a covariate in analyses of chute score and exit velocity. Records were placed in 3 RFI groups: high, medium (mean ± 0.5 SD), and low values, and this term was modeled as a fixed effect in additional analyses. Sire was a random effect. Brahman heifers had more favorable ($P < 0.05$) RFI (–1.08 ± 0.25 kg) than other groups which ranged from 0.06 ± 0.17 (R) to 0.46 ± 0.2 kg (A). Brahman ADG (0.84 ± 0.06 kg) was less than ($P < 0.05$) that of Angus heifers (1.06 ± 0.05 kg). Means for ADG of crossbred heifers were 0.86 ± 0.08 (RB), 1.08 ± 0.1 kg (BA), and 1.1 ± 0.09 kg (RA). No breed effect was detected for FCR ($P = 0.31$). Brahman and Brahman-cross heifers had the largest exit velocity means (range from 2.89 ± 0.15 for RB to 3.43 ± 0.19 m/s for BA); these were larger ($P < 0.05$) than Angus (2.22 ± 0.12 m/s) and Romosinuano (2.12 ± 0.1 m/s). Chute temperament score means for Angus (2.38 ± 0.1) and RA (1.9 ± 0.26) were lower ($P < 0.05$) than those of all other breed groups. Groups for RFI did not explain variation in analyses of temperament traits ($P > 0.29$).

Key Words: Brahman, Residual Feed Intake, Temperament

T72 Organ weights and ulcer severity of 1980 vs. 2005 pigs when fed 1980 or 2005 feeding programs. J. S. Fix, E. van Heugten, D. J. Hanson, J. P. Cassady, and M. T. See*, *North Carolina State University*, *Raleigh*.

The objective of this study was to assess changes over 25 years in pig organ weights and ulcer severity. Pigs (n=162) representative of current commercial industry were compared to pigs representative of commercial industry 25 years ago. The 1980 genetic line was produced from dams selected to minimize genetic improvement and frozen semen from boars available in 1980. Pigs within sex, farrowing group, and genetic line (GL) were randomly assigned to a feeding program (FP) and placed 3 per pen (n=54) at an initial wt of 7±0.4 kg. The 2005 FP included 7 pelleted diets (lysine from 1.51 to 0.73% and ME from 3428 to 3651 Kcal/kg) and current diet formulation. The 1980 FP consisted of 4 meal diets (lysine from 1.05 to 0.62% and ME from 3262 to 3317 Kcal/kg) based on formulations from 1978 PIH. Pigs were slaughtered and viscera were collected on a weekly basis when average pen wt exceeded 116 kg. Heart, lungs, liver, kidneys, pancreas and all non organ matter were separated and weighed. Stomach, small intestine and large intestine were separated, cleaned and weighed. Weights were adjusted to constant BW of 116 kg. Stomachs were scored for ulcer and keratinization severity on a scale of 1-7 (1=normal to 7= severe ulceration). The 2005 GL pigs had heavier small intestines (1599 vs. 1375 g; $P < 0.01$), large intestines (1548 vs. 1405 g; $P < 0.05$), hearts (392 vs. 374 g; $P < 0.05$) and livers (1614 vs. 1550 g; $P = 0.05$) than pigs from 1980 GL. Pigs fed 1980 FP had heavier large intestines (1582 vs. 1371 g; $P < 0.01$) and lungs (673 vs. 611 g; $P < 0.05$) than pigs fed 2005 FP. A GL x FP interaction ($P < 0.01$) was observed for kidney weight where 1980 GL pigs fed 1980 vs. 2005 FP had heavier kidneys while 2005 GL pigs fed 1980 vs. 2005 FP had lighter kidneys. Pigs fed 1980 FP had heavier stomachs (624 vs. 518 g; $P < 0.01$) and less ulcer severity (2.26 vs. 3.53; $P < 0.01$) than pigs fed 2005 FP. Changes in genetics led to heavier organ weights but did not affect stomach ulcer severity. Changes in feeding program resulted in lower organ weights and an increase in stomach ulcer severity.

Key Words: Pigs, Genetics, Stomach Ulcers

T73 Genetic and environmental factors that affect gestation length. H. D. Norman, J. R. Wright, M. T. Kuhn, S. M. Hubbard*, and J. B. Cole, *Agricultural Research Service, USDA*, *Beltsville, MD*.

Genetic and environmental factors that might affect gestation length (GL) were investigated so that more accurate predictions of calving dates could be provided to dairy producers. Data from >8 million calvings from 1999 through 2005 for 5 dairy breeds were assembled from lactation, reproduction, and dystocia records from across the United States. Effects examined were calving year, calving herd-year, calving month, age-parity, calf birth code (gender and multiple-birth status), lactation length, milk yield, service sire, sire, and cow. All effects were fixed except for service sire, sire, and cow. Mean GL for cows (parities 2 through 5) was 279.5 d for Holsteins, 280.1 d for Jerseys, 281.9 d for Ayrshires, 285.8 d for Guernseys, and 287.6 d for Brown Swiss. Mean GL for heifers (parity 1) was 277.9 d for Holsteins, 278.6 d for Jerseys, 281.8 d for Ayrshires, 285.0 d for Guernseys, and 287.0 d for Brown Swiss. Estimated standard deviation of GL was greatly affected by data restrictions but appeared to be near 6 d for all breeds. For Holstein cows, calving year differences in GL were small, but effect of calving month was large; mean GL was 278.2 d for July compared with 280.4 d for November. Mean GL for Holstein cows with twins was 274.9 d compared with 279.4 and 280.5 d for those with single-birth females and males, respectively. Holstein cows with lactations of ≤250 d had a mean GL of 280.1 d compared with 278.8 d for cows that were milked for >500 d. Holstein cows with standardized yield of ≤6,000 kg had a mean GL of 279.0 d compared with 279.8 d for cows with yield of >16,000 kg. Heritability estimates for GL derived from parities 2 to 5 were 24% for service sire and 8% for sire. Better prediction of time of parturition can help herd managers to fulfill the nutritional needs of pregnant cows and to administer better preventive health care so that metabolic diseases are minimized during high risk phases of cows' lives.

Key Words: Gestation Length, Calving Date

T74 Construction of a cDNA library of the guinea fowl adipose tissue and evaluation for expressed sequence tags. S. N. Nahashon*, G. Kelley, J. Johnson, J. Tyus II, and A. Amenyenu, *Institute of Agricultural and Environmental Research, Tennessee State University*, *Nashville*.

Fat accretion in poultry directly influences the efficiency of feed utilization and consumer acceptability of poultry and poultry products. Excessive fat deposition, which is undesirable to poultry processors and consumers alike, also reduces meat quality. Losses estimated at about US$250-300 million are incurred by consumers and processors annually in pollution control, fat extraction and in discarding excess

carcass fat. Understanding the mechanisms that lead to excessive fat deposition in birds will be an avenue to improving poultry carcass quality while minimizing production cost. The aim of the proposed project was to generate a cDNA library for the guinea fowl adipose tissue. The guinea fowl is genetically diverse from other avian species such as chickens and turkeys and its carcass and abdominal fat content is significantly lower than that of these other avian species. Therefore, genome sequence information realized from the cDNA library would provide a tool for comparative mapping of the avian species and an understanding of the factors associated with fat accretion in poultry. A partial sequence cDNA library of the guinea fowl adipose tissue was constructed using the Stratagene® cDNA library construction kit. DNA sequences were cloned into the pBluescript cloning vector and screened by the polymerase chain reaction. Two hundred clones were cycle-sequenced using the Dye Terminator® cycle sequencing kit and the ABI 3100 Genetic Analyzer. Similarity of DNA sequences was evaluated using the National Center for Biotechnology Information (NCBI) databases using the BLAST (http://www.ncbi.nlm.nih.gov/BLAST/). About 90% of the DNA sequences retrieved were unique to the guinea fowl and they range in size from 386 to 1,059 bases. About 15% of these sequences had less than 20% match with mammalian sequences, whereas 85% exhibited homology ranging from 55-96% with avian species and 44-75% with mouse and human DNA sequences. These sequences provide an invaluable tool for comparative mapping of the avian genome and an understanding of the mechanisms underlying excessive fat accretion in poultry.

Key Words: cDNA Library, Guinea Fowl Adipose Tissue, Poultry

T75 Optimising turkey parent stock selection for an integrated processing company and a non-integrated poult supply company. B. J. Wood* and N. Buddiger, *Hybrid Turkeys*, *Kitchener, Ontario, Canada.*

Mass selection on body weight is an effective method that can improve the commercial performance of progeny from selected parent stock (PS). Selection on body weight is a common procedure within the North American industry with the industry averaging 50% selection from the total number of PS tom poults placed. Increased selection pressure increases costs in two ways, first, increased numbers of PS are required, and second, facilities in to house additional PS. The aims were to economically model PS selection to determine the optimum selection intensity to maximise profit when either an independent poult supplier or integrated turkey processing company. Poult production costs increased slowly above non-selection to $0.01 per poult at 50% selection and then increased more rapidly to $0.04 and $0.12 at 20% and 10%, respectively, thereafter, at higher intensities the price increased exponentially. For a non-integrated company, returns are generated purely on the sale of poults with benefits accrued from increased market share or higher poult price and so must be determined on an individual company basis. For integrated companies return on investment comes in the form of improved live performance and processing. Body weight was assumed to have a heritability of 0.4 and genetic (r_g) and phenotypic (r_p) correlation between male and female bodyweight was assumed to be r_g = 0.85 and r_p = 0.70, respectively. Correlations between bodyweight and feed intake, BMY and mortality were assumed to be to be r_g = -0.15, -0.16, 0.2 and $_p$ = -0.15, -0.12 and 0.15, respectively. The optimal intensity was between 15% and 25% depending on breast meat and feed price which corresponded to the level where there was substantial increase in poult cost. Optimal selection age was always the same as slaughter age and hen selection was shown not to be profitable at any selection pressure level. It could be concluded that current PS tom selection intensities could be increased with substantial increases in profit compared with current industry levels.

Key Words: Economic Model, Parent Stock Selection, Genetics

T76 Defining the haplotype blocks in outbred livestock populations. M. Jafarikia*, J. A. B. Robinson, and D. Ashlock, *University of Guelph*, *Guelph, Ontario, Canada*.

Recent studies propose a block-like structure for genome haplotypes. There are two major methods for defining the haplotype blocks based on finding a region with limited diversity, and detecting regions with high levels of historical recombination. In order to develop a methodology to define the haplotype blocks in outbred livestock populations, maximum likelihood was used in a simulation study to detect the hotspot regions, using the information from the genotypes of grand sires and their sons in the following formula:

$$X^2 = -2\ln(\Pi[(p^{r_i}q^{(n_i-r_i)})/(p_i^{r_i}q_i^{(n_i-r_i)})]\Pi q^{n_i})$$

where X^2 was the LR value for every informative interval and p as a population measurement, was the probability of having recombination in an informative interval computed from the total number of recombinations divided by the total number of informative intervals in the population: $p=\Sigma r_i/\Sigma n_i$ where the number of grand sires (families) was from i=1 to GS. r_i and n_i denoted the number of recombinations in the progeny of every grand sire, and the total number of informative intervals in the progeny of every grandsire respectively. p_i was a family measurement which is the number of recombination in the progeny of a grandsire divided by the total informative intervals of that grand sire, $p_i=r_i/n_i$. q and q_i were the possibility of having no recombination in an informative interval in the population and family respectively. n_i-r_i was the number of progeny which did not show any recombination in meiosis. In order to test the method, a simulated ten cM chromosome having 30 SNPs in a population with five grand sires and 80 sires per grandsire and two blocks of haplotypes was developed. The possibility of recombination was 95% in hotspot region and 5% in coldspots region. The proposed method was able to successfully detect the hotspot regions ($P<0.001$).

Key Words: Haplotype Blocks, Recombination Hotspot, Maximum Likelihood

T77 Nutritive value of corn protein co-products from the ethanol industry. M. R. C. de Godoy*, L. L. Bauer, C. M. Parsons, and G. C. Fahey, Jr, *University of Illinois*, *Urbana*.

The objectives of this study were to determine the chemical composition and nutritive value of corn protein concentrates, (CPC_1, CPC_2), novel co-products from the ethanol industry, compared with conventional plant protein ingredients (soybean meal [SBM], distillers dried grains with solubles [DDGS], corn gluten meal [CGM], and corn germ meal [CGeM]). Protein efficiency ratio (PER), standardized amino acid digestibility, and true metabolizable energy (TME_n) data were obtained with chicks. Corn protein concentrates were produced from a pilot modified wet milling plant, with CPC_1 having a higher degree of purification than CPC_2. Crude protein values for CPC_1 and CPC_2 were 57.3 and 49.7%, respectively. Total dietary fiber concentration was 29% for CPC_1 and 23.5% for CPC_2. Acid hydrolyzed fat and gross energy concentrations were similar for these ingredients. No statistical differences in feed intake, weight gain, or protein intake were noted among CPC_1, CPC_2, and CGM. However, CPC_1 resulted in a higher gain/feed and PER ratio than CPC_2 and CGM. Overall, SBM was superior for all growth outcomes analyzed in this assay. For standardized amino acid digestibilities, CGM had the highest numerical values for total amino acids (TAA), total essential amino acids (TEAA), and total nonessential amino acids (TNEAA), but they were not statistically different from CPC_1 and SBM values. Corn germ meal resulted in the lowest values for the same criteria and were not significantly different from DDGS and CPC_2. Corn protein concentrates were not different from each other in TNEAA digestibility. Highest values for TME_n were obtained with CGM, followed by CPC_1, DDGS, CPC_2, SBM, and CGeM. Distillers dried grains with solubles and CPC_2 had similar values and were not different than CPC_1 and SBM. In conclusion, CPC_1 was of higher quality than CPC_2 and CGM in the PER assay. As regards amino acid digestibility, CPC_1, CGM, and SBM were of comparable quality, and CPC_2 was similar to DDGS and CGeM.

Key Words: Corn Protein, Nutritive Value, Ethanol

T78 Chemical composition of fiber rich corn co-products from the ethanol industry. M. A. Guevara*[1], L. L. Bauer[1], C. A. Abbas[2], K. E. Beery[2], M. A. Franklin[2], M. J. Cecava[2], and G. C. Fahey, Jr.[1], [1]*University of Illinois*, *Urbana*, [2]*Archer Daniels Midland Company*, *Decatur, IL*.

Understanding the impact of different processing methods and steps on preparation of fiber-rich corn co-products is a pre-condition to the interpretation and potential use of these products as fiber sources in dog foods. To determine the chemical composition of selected fiber-rich corn co-products from the ethanol industry, samples of native corn fiber (NCF), hydrolyzed corn fiber (HCF), and hydrolyzed extracted corn fiber (HECF) were analyzed for concentrations of total dietary fiber (TDF), acid hydrolyzed fat (FAT), crude protein (CP) , and hydrolyzed monosaccharides corrected for free sugars (HMC). Compositional data are presented in the following table. Values in parentheses represent the range in values among the co-products. Data indicate that compositional differences exist dependent upon processing methodology utilized. The desired outcome is to produce a consistent high fiber corn co-product with little variation in chemical composition and with a predictable physiological effect when incorporated into canine diets.

Table 1.

Co-Product	%TDF	%CP	%FAT	HMC, mg/g
NCF	67.3 (52.6-73.5)	12.3 (10.4-14.5)	6.8 (4.9-8.3)	683 (600-754)
HCF	57.3 (46.4-71.5)	14.4 (11.1-15.9)	7.2 (5.5-8.6)	473 (450-524)
HECF	70.8 (61.7-79.3)	12.5 (11.9-13.5)	2.4 (1.6-3.8)	575 (520-693)

Key Words: Corn Fiber, Composition, Ethanol

T79 Using ultrasound as an alternative method for determining body fat content in beagles. R. M. Yamka*, K. G. Friesen, C. A. Stiers, and B. A. Stone, *Hill's Pet Nutrition, Inc.*, *Topeka, KS*.

The objective of this study was to determine if % body fat content in beagles can be determined using ultrasound. Three hundred beagles (average age = 7.3 ± 2.7 years and average weight = 14.8 ± 3.1 kg) were identified for this study. All dogs underwent dual-energy x-ray absorptiometry (DXA; DXA-QDR-4500, Hologic, Inc., Waltham, MA) scans to determine body fat, muscle and bone content (average % fat = 35.6 ± 6.1). Prior to the DXA scans, each dog was weighed and back fat depth was measured three times via ultrasound at the spine between wings of the ileum (average back fat = 1.2 ± 0.4 cm). In addition, girth (average = 53.2 ± 5.6 cm) and femur length (average = 16.5 ± 1.6 cm) measurements were also taken. Through stepwise regression it was determined which measurements were important for predicting % body fat. Body weight was excluded from all models. The three models identified for predicting body fat, included: Equation 1) 24.99 + (9.12*back fat); R2 = 0.38; Equation 2) 24.13 + (0.72* girth) - (1.64*femur length); R2 = 0.39; Equation 3) 31.06 + (0.38*girth) - (1.43*femur length) + (6.73*back fat); R2 = 0.51. The results of this study indicate that ultrasound can be used to accurately predict body fat content in beagles.

Key Words: Dogs, Ultrasound, Body Fat

T80 Effects of feeding increasing levels of base excess on stool quality and output in dogs. R. M. Yamka*, K. G. Friesen, L. J. Kats, and T. G. Forster, *Hill's Pet Nutrition, Inc.*, *Topeka, KS*.

The objective of these studies was to determine the effects of feeding varying levels of base excess on stool quality and number of defecations (output). Seven foods varying in base excess (-107 to +62 meq) were fed to groups of 10 beagles (average age = 9.6 ± 2.0 years; average weight = 10.0 ± 1.2 kg) for a period of 7 days in order to determine the effect of base excess on stool quality and output. Base excess (in meq) was calculated as (Na + K + Ca + Mg) - (Cl + S + P). All foods were fed at maintenance level. Stool quality and output was determined daily. Stool quality was rated on a five point scale (5 = dry formed stool and 1 = unformed wet stool). The data from these stool studies

indicate that base excess is directly related to dog stool quality (R2 = 0.81) and to stool output or number of defecations (R^2= 0.69). Dogs fed foods with decreasing base excess (more positive) had higher stool scores and a reduction in total stool output. When formulating foods for dogs, base excess can be used to manipulate the type of feces desired. Foods with decreased base excess (positive) would be beneficial for increasing stool quality and foods with increased base excess (negative) could prevent constipation.

Key Words: Dogs, Stool, Base Excess

T81 Estimating intestinal protein digestion in the canine animal using a ruminant *in vitro* model. M. Thrune[1], M. D. Stern*[1], M. Ruiz-Moreno[1], and G. C. Fahey, Jr[2], [1]*University of Minnesota*, *St. Paul*, [2]*University of Illinois*, *Urbana-Champaign*.

An experiment was conducted to test the viability of using a modified three-step procedure for estimating intestinal crude protein in ruminants on intestinal digestion in the canine for a variety of dry kibble diets containing various protein sources. The original three-step *in vitro* procedure was developed to determine small intestinal crude protein digestion in ruminants. A modification of this published protocol was used in the present experiment, comparing measured values to *in vivo* values determined in experiments using dogs as the experimental animal. Nineteen different plant and animal by-product protein sources were used in this experiment: high protein corn (HP), high protein, low phytate corn (HPLP), high amylase corn (HA), conventional corn (CONV), amylomaize starch corn (AM), control (CON), 1% chicory (CH), 1% mannanoliogosaccharide (MOS), 1% chicory + 1% mannanoligosaccharide (CM), soy hull 1.86 (SH 1.86), soy hull 2.65 (SH 2.65), soy hull 3.17 (SH 3.17), soy hull 5.18 (SH 5.18), soy hull 7.21 (SH 7.21), beet pulp (BP), control (CONB), soybean meal (SBM), poultry meal (PM) and Profine-E (SPC2). Samples were exposed to a shaking water bath and a pepsin (1 hr, 38.6°C, pH=1.9)-pancreatin (24 h, 38.6°C, pH=7.8) enzymatic solution to mimic digestion in the small intestine. Simple regression analysis of *in vitro* protein digestibility versus *in vivo* protein digestibility was performed. *In vitro* intestinal protein digestion values were numerically similar ($P < 0.05$) to those measured *in vivo*, however there was not a high correlation between values ($r^2 = 0.41$). Results from this experiment do not substantiate the use of the *in vitro* intestinal ruminant protein digestion model to assess *in vivo* dietary crude protein digestibility in dogs.

Key Words: Canine, Intestinal Digestion, *In Vitro*

T82 The ameliorating effect of ascorbic acid on subacute sperm toxicity in male New Zealand White Rabbits treated with endosulfan. A. Ata, F. S. Hatipoglu, O. Y. Gulay*, and M. S. Gulay, *Mehmet Akif Ersoy University*, *Burdur, Turkey*.

Protective role of oral ascorbic acid (AA) was evaluated against changes in sperm parameters in New Zealand White (NZW) rabbits treated with endolsulfan. Rabbits (6 to 8 months old) were divided into four groups of six animals each. Rabbits in TRT-I served as control and received corn oil by oral gavage for 6 weeks. Rabbits in TRT-II received endolsulfan (1 mg/kg bw/day) in corn oil. TRT-III group received oral corn oil daily and ascorbic acid (AA; 20 mg/kg bw) every other day for 6 weeks. TRT-IV group received the same amounts of endosulfan and AA. Endosulfan alone significantly reduced the sperm count and motility and increased the presence of sperm with morphological problems ($P<0.01$). AA treatment showed significant amelioration on sperm count and motility decreased the presence of sperm with morphological problems when coupled with endosulfan ($P<0.01$). Ameliorations were up to control levels in all cases except for sperm motility. Data suggested that AA has beneficial influences in neutralizing the negative effects of endosulfan in the spermatologic parameters of NZW males.

Key Words: Ascorbic Acid, Endosulfan, Subacute Sperm Toxicity

T83 Subacute oral endosulfan toxicity in male New Zealand white rabbits. F. S. Hatipoglu*[1], M. S. Gulay[1], O. Y. Gulay[1], A. Balic[2], and S. Volkan[3], [1]*Mehmet Akif Ersoy University*, *Burdur, Turkey*, [2]*Sakarya State Hospital*, *Adapazari, Turkey*, [3]*Dunya Tip Center*, *Burdur, Turkey*.

The present study was conducted on 6 to 8 month old New Zealand white rabbits (9 rabbits per treatment group). Daily gavages of 3, 1.5, 0.75 or 0 mg endosulfan/kg resulted in the death of 5, 3, 0, and 0 animals, respectively, in each group of 9. All rabbits were monitored for any observable toxic symptoms throughout the experimental period (30 d) and they were also weighed weekly to monitor body weight gain. Nervine symptoms like tremor, head down condition and torticolis were noticed only for few minutes before death. All deaths occurred within the first 3 weeks. Some alteration had been recorded in hematological parameters within the groups (hemoglobin, packed cell volume, and total erythrocyte count) due to endosulfan exposure. Serum alkaline phosphatase (ALP) and aspartate aminotransferase (AST), but not Alanine aminotransferase (ALT), levels were significantly elevated in the 3 mg/kg dose group. Gross postmortem and histopathological changes in various organs (lung, liver, kidney, and testes) of rabbits treated with endosulfan were typical to dose dependent organochlorine insecticide toxicity signs. Thus, although some animals appear to adjust to relatively high daily doses of endosulfan, biochemical and histological evidence indicates varied liver and kidney damage according to dosage administered in these animals. Current subacute study suggested in a "no-observed-effect-level" of 0.75 mg endosulfan/kg in New Zealand white rabbits.

Key Words: New Zealand White Rabbits, Subacute Oral Endosulfan Toxicity, Blood Parameters

T84 Effects of feedborne Fusarium mycotoxins with and without a polymeric glucomannan mycotoxin adsorbent on body weight, feed intake, serum chemistry, and nutrient digestibility of mature beagles. M. C. K. Leung, T. K. Smith*, N. A. Karrow, and H. J. Boermans, *University of Guelph*, *Guelph, ON, Canada*.

There have been several mycotoxin outbreaks involving commercial cereal-based dog food in the recent years. While acute aflatoxicosis in dogs is frequently reported and studied, little canine research has been devoted to Fusarium mycotoxins which are commonly found in temperate regions, including Canada and United States. An experiment was, therefore, conducted (1) to investigate the effects of feeding

cereal-based diets naturally contaminated with a combination of Fusarium mycotoxins to dogs and (2) to test the efficacy of a polymeric glucomannan mycotoxin adsorbent (GMA) in prevention of Fusarium mycotoxicosis. Twelve mature beagle females averaging 10.1 ± 1.1 kg of body weight and 2.8 ± 1.6 years of age were assigned to one of three diets for 14 days in a 3 × 3 Latin square design. The diets included (1) control, (2) contaminated grains, and (3) contaminated grains + 0.2% GMA (Mycosorb, Alltech Inc., Nicholasville, KY). The two contaminated diets averaged 3.3 mg deoxynivalenol, 0.3 mg 15-acetyl deoxynivalenol, 0.4 mg zearalenone, and 9.2 mg fusaric acid per kg feed. Feed intake and body weight of dogs fed the contaminated diet were significantly reduced compared to controls. Reductions in serum concentrations of total protein, globulin, fibrinogen, alkaline phosphatase, and amylase were also detected ($P < 0.05$). The feeding of GMA did not ameliorate the effects of the Fusarium mycotoxins. Dogs fed the contaminated diet + GMA had higher digestibility of carbohydrate, protein and lipid as compared to controls, possibly due to physiological adaptation to reduced feed intake. It was concluded that the feeding of grains naturally contaminated with Fusarium mycotoxins can adversely affect feeding behavior and metabolism of dogs. The protective efficacy of GMA, however, was not seen at the current level of dietary inclusion.

Key Words: Dog, Fusarium Mycotoxin, Glucomannan Mycotoxin Adsorbent

T85 Prevalence of gastrointestinal parasites in dogs housed at the Animal Protection Association of Culiacan, Sinoloa. M. C. Rubio Robles*, S. M. Gaxiola, N. Castro, I. Padilla, J. Raygoza, E. D. Vega, F. Valdez, and B. A. Zazueta, *Universidad Autonama de Sinaloa*, *Culiacan, Sinaloa, Mexico*.

The objective of this work was to determine the prevalence of gastroenteric parasites in dogs housed at the animal protection association of Culiacán, Sinaloa. A representative sample with both sexes and cradle described by the technique of Thrusfield (1995) was used: n=[t*SD/L]2. Where n = sample size, t = value of the normal distribution (Student t) for a 95% confidence level (t = 1.96), L = accepted error or precision (5%), and SD = weighted disease prevalence (%). On the basis of the technique described, the total number of sample animals determined for random sampling was 25. For each dog feces were collected rectally by digital stimulus into previously identified plastic bags. The samples were transported under refrigeration at 4°C to the Parasitology Laboratory of the FMVZ-UAS, and processed by the flotation technique with sugar solution. The results indicate that of the data from the 25 dogs analyzed 12(48%) were positive for gastrointestinal parasites, with the following distribution: Isospora canis 4 (16%), Giardia spp., 3 (12%), Ancylostoma caninum 3 (12%), Dipylidiun spp. 2 (8%). This is a considerable number and proportion of animals testing positive continues to be an issue of importance in the local community because frequently these dogs are adopted and taken to different points throughout the city with new pet owners that are not informed about parasitisms afflicting these animals. Further, these adopted dogs can serve as vectors for the transmission of parasites to the broader community if left untreated.

Key Words: Parasites, dog, Prevalence

Contemporary & Emerging Issues - Livestock and Poultry

T86 Survey of *Clostridium septicum* isolated from market-age turkeys with cellulitis. T. Neumann*, D. Karanakarun, and T. Rehberger, *Agtech Products, Inc.*, *Waukesha, WI*.

Subcutaneous clostridial infections have become increasingly problematic for poultry producers in the United States. One of the most commonly implicated organisms is the anaerobic, spore-forming bacteria *Clostridium septicum*. Although poorly understood, *C. septicum* is regarded as the causative agent of atraumatic myonecrosis. Cellulitis is a disease of turkeys that is similar in its presentation to gangrenous dermatitis in broilers. Symptoms include severe necrosis of the subcutaneous tissues of the abdomen and inner thighs accompanied by edema and gas production. The disease occurs most often with no identifiable loss in the skin's integrity. This survey was conducted to gain a better understanding of the prevalence and diversity of *C. septicum* on endemic disease farms. A total of 189 tissue samples from turkeys suspected to have died from cellulitis were received from 62 endemic cellulitis farms. Turkeys sampled came from producers located in five states; Missouri (MO), Wisconsin(WI), Virginia(VA), North Carolina(NC) and Minnesota(MN). Isolates of *C. septicum* were cultured anaerobically on TSC agar and identified by PCR. DNA fingerprints of the isolates were generated by RAPD PCR. A family tree was constructed from the fingerprints to examine relationships among the strains. *C. septicum* was identified on 69.35% of the farms sampled. The prevalence in MO, VA and NC was 80% (24/30), 80% (8/10) and 100% (6/6) respectively. Only three WI farms out of thirteen sampled tested positive for *C. septicum*. Two out of three MN farms tested were positive. It is probable that the prevalence is actually higher than what is reported here due to low sample size from a number of farms. Interestingly, the WI farms sampled had a substantially lower prevalence of *C. septicum* than the other four states (23.1% vs. 81.6%). Field observations indicated a less severe manifestation of the disease at these WI farms, and most farms sampled (76.9%) were positive for *Clostridium perfringens* in examined tissues. Also interesting was the identification of two unique subtypes of C. septicum, one found in VA and NC and the other predominant in the Mid-West.

Key Words: Clostridium, Cellulitis, Turkeys

T87 Assessment of clostridial challenges present in asymptomatic birds raised in a commercial broiler facility. S. Dunham*[1], J. A. Smith[2], and T. Rehberger[1], [1]*Agtech Products, Inc.*, *Waukesha, WI*, [2]*Fieldale Farms Corporation*, *Baldwin, GA*.

Gangrenous dermatitis (GD) is a reemerging acute bacterial disease of poultry that causes necrosis of the skin, abdominal subcutaneous tissue, and underlying musculature that progresses rapidly. With mortality reaching as high as 1% each day for up to two weeks, GD is a significant concern for poultry producers throughout the U.S. *Clostridium* species, specifically *C. perfringens* and *C. septicum*, are the most common causative agents isolated from skin lesions

associated with GD. The objective of this study was to assess the clostridial challenges present in asymptomatic broilers raised under different feeding regimes: a conventional program, including non-endemic and endemic GD sites, and an antibiotic free (ABF) program. Three birds from seven different flocks from each of the three groups were sampled at approximately five weeks of age to obtain gastrointestinal tract (GIT), liver, and spleen samples from 63 total birds. The samples were plated on selective media and multiplex PCR was performed to verify toxigenicity. Of the total birds sampled in each group, 33.3% from the conventional GD broilers, 19.0% from the conventional non-endemic broilers, and 38.1% from the ABF broilers were positive for toxigenic *C. perfringens* but not for *C. septicum*. All livers and spleens were negative for known toxigenic *Clostridium*. RAPD PCR was performed on the *C. perfringens* isolates and used to construct a dendrogram to determine genetic diversity. Isolates from different birds within a site, as well as isolates from different sites in the same program showed genetic relatedness, however, no clear correlation could be made to identify pathogenic lineages. The most notable finding in this study was that an unidentifiable anaerobic gram positive rod-shaped organism, possibly a unique toxigenic *Clostridium* species was found in 28.6% of endemic GD birds, 23.8% of nonendemic birds, and 14.3% of ABF birds. Future research will focus on obtaining samples of live birds with symptoms of GD from endemic sites to determine if this unknown organism is involved in GD disease.

Key Words: Poultry, *Clostridium*, Broilers

T88 Prevalence of unusual viral RNA, enteropathogens, Cryptosporidia in poultry litter, pig wastes and waterways of Ireland and their impact on environmental health. J. R. Rao*[1,2], D. W. A Nelson[2], L. Xiao[3], M. Matsuda[4], T. Sekizuka[4], C. J. Lowery[6], J. S. G. Dooley[6], B. C. Millar[5], P. J. Rooney[5], and J. E. Moore[5], [1]*Environmental and Public Health Microbiology Unit, Agri-Food & Biosciences Institute*, *Belfast, Northern Ireland, UK*, [2]*The Queen's University of Belfast*, *Belfast, Northern Ireland, UK*, [3]*Division of Parasitic Diseases, Centers for Disease Control and Prevention*, *Atlanta, Georgia*, [4]*Laboratory of Molecular Biology, School of Environmental Health Sciences, Asabi University*, *Fuchinobe, Sagamihara, Japan*, [5]*Northern Ireland Public Health Laboratory, Department of Bacteriology, Belfast City Hospital*, *Belfast, Northern Ireland, UK*, [6]*School of Health and Life Sciences, University of Ulster*, *Coleraine, County Londonderry, Northern Ireland*.

Contaminated straw and water used in the poultry houses were among the most likely sources suggested for the entry of viruses including highly pathogenic H5N1 (AIV) in France or Germany. We found (see review Rao et al 2007 CIMB, 9: 103-122) that mushrooms and substrate composts (raw ingredients straw and poultry litter) carried unusual compendium of dsRNAs associated with mushroom virus (X). In Ireland, a viable option for disposal of raw or composted animal agriculture farm waste is land spreading as a cheap nutrient supplement but many are unaware of the silent dangers of pathogen spreading from this practice. Our results indicated that a number of novel eubacteria together with faecal parasites (e.g. Cryptosporidium spp) and some complex viral RNA components were prevalent in mostly wet straw / compost wastes arising from poultry litter and slurry or slurry solids from pig farms, particularly of those located in the vicinity of the mouth of rivers. Our model study was carried out in Lough Neagh, County Antrim, Northern Ireland as it enters into the province's largest watercourse, a niche for flocks of mute swans (Cygus olor) from north-western continental Europe which are partially migratory or nomadic. The migratory bird populations inhabit surface waters, including rivers, ponds and lakes. Following varying degrees of water treatment, the water is utilized for t animal production, particularly poultry and/or pig farms; the Lough itself is frequently used for recreational purposes, including wind-surfing and water/jet-skiing. We also report our findings on the potential risk of avian carriage of viral elements, bacteria or parasitic faecal pathogens and emerging zoonoses that could be potentially transmitted via poultry dwellings in contact with the water and the impending risk to plant, animal and human health.

Key Words: Unusual Viral RNA, Enteropathogens, Avian Influenza

Dairy Foods: Cheese, Dairy Products and Chemistry

T89 The impact of fat reduction on flavor and flavor chemistry of Mozzarella cheeses. A. J. Krause*, R. E. Miracle, J. P. Evans, and M. A. Drake, *North Carolina State University*, *Raleigh*.

Mozzarella cheese is available on the market in whole milk, part-skim milk, and fat-free varieties. Fat-free Mozzarella lacks the milkfat flavor and richness of its whole and part- skim milk counterparts. It has been theorized that lactones may be responsible for the delicate sweet aromatic flavor in full fat Mozzarella cheeses and their addition to lower fat cheeses could produce more desirable flavors. In this study, the sensory profiles and volatile compounds in all three types of Mozzarella cheese were characterized. Whole milk, part-skim, and fat-free Mozzarella cheeses were obtained from a commercial supplier on multiple occasions. Cheeses were evaluated by a trained descriptive panel and by instrumental volatile analysis. For instrumental analysis, volatiles were extracted by solid phase micro-extraction (SPME) and solvent extraction followed by solvent assisted flavor evaporation (SAFE). SPME samples were injected on a gas chromatograph with mass spectrometry detection (GC-MS). Duplicate samples extracted with diethyl ether and concentrated were evaluated by subsequent GC–olfactometry and GC–MS with aroma extract dilution analysis (AEDA). Compounds were identified by retention index, aroma of reference compounds and mass spectra. The mozzarellas were differentiated by both sensory and instrumental volatile analyses ($p<0.05$). Descriptive panelists differentiated the full fat, part-skim and fat-free cheeses by the attributes cooked, milkfat, and sour taste. Fat free cheeses lacked milkfat flavor and exhibited lower cooked flavor and sour taste when compared to the other cheeses. Volatile flavor compounds that differed significantly ($p<0.05$) among the cheeses included: esters, sulfur compounds, and lactones which corresponded to the main flavor variables from the trained panel. Direct injection of solvent extracts showed higher levels of delta lactones in whole milk cheese versus part-skim or fat-free product. These results suggest that lactones contribute to the characteristic sweet aromatic flavor of whole milk Mozzarella cheese.

Key Words: Mozzarella, Flavor Chemistry, Flavor

T90 Fate of lysostaphin in milk through the cheesemaking process. D. L. Van Hekken*[1], R. J. Wall[2], G. A. Somkuti[1], and P. M. Tomasula[1], [1]*USDA-ARS*, *Wyndmoor, PA*, [2]*USDA-ARS*, *Beltsville, MD*.

Transgenic cows secreting over 3 µg lysostaphin/mL milk are usually resistant to mastitis caused by *Staphylococcus aureus*, but it is unclear if active lysostaphin will persist through dairy processing steps or impact the production of fermented dairy foods. The objective of this study was to determine the fate of lysostaphin as milk is pasteurized and then processed into cheese. Raw milk from transgenic cows was heat treated at 63°C for 30 min, 73°C for 15 sec (HTST), and 135°C for 2 s. Only the HTST milk was processed into a semi-hard cheese. Aliquots were taken at each processing step and assayed to determine the quantity (ELISA) and activity (ability to inhibit S. aureus growth) of lysostaphin. Results indicated that the majority of the lysostaphin was present in the skim milk portion and was not affected by pasteurization. Although the quantity and activity of the lysostaphin decreased during cheesemaking, active lysostaphin was present in the whey and cheese, even after 90 d of 4°C aging. Because lysostaphin is not a natural milk constituent, further research is required to evaluate its potential as a bioprotective agent against staphylococci and its impact on food quality.

Key Words: Cheese, Milk, Transgenic Cows

T91 Effects of High Pressure Processing on the reduction of *Listeria monocytogenes* in the manufacture of soft cheeses. C. P. Rodriguez*[1], E. Patazca[1], and J. E. Schlesser[2], [1]*National Center for Food Safety and Technology-Illinois Institute of Technology*, *Summit-Argo, IL*, [2]*National Center for Food Safety and Technology-FDA*, *Summit-Argo, IL*.

During the ripening or storage of soft cheeses food borne pathogens may survive and grow due to the high moisture content and increase in pH during aging. High pressure processing (HPP) has been proposed as an alternative to heat treatment for the reduction of pathogens in the manufacture of soft cheese. Possible advantages of HPP of cheese would include reduction of pathogens levels without affecting cheese aging. The effectiveness of HPP to reduce *L. monocytogenes* on Camembert cheese was evaluated. Camembert cheese was inoculated with a cocktail of 5 *L. monocytogenes* strains (903, 1364, 1446, Scott A and OSY 8578). Samples were tested at various levels of high pressure, processing time and final temperature. Cheese samples (~35g) were immersed in the *L. monocytogenes* cocktail, drained, and packed in high barrier nylon/EVOH/PE vacuum pouches with a double seal. Samples were triple bagged. Quality assessment was determined by analyzing untreated uninoculated whole cheeses for texture, color and regrowth of mold mycelium. Cheese samples treated at 400 to 500 MPa, 25°C for 2 to 5 min resulted in less than $1\log_{10}$ reduction in levels of *L. monocytogenes*. HPP at 600 MPa, 25°C and 45°C for 2 to 5 min and HPP at 700 MPa, 35°C for 5 min resulted in a 4 to $5\log_{10}$ reduction in levels of *L. monocytogenes*. A 5 or more $\log_{10}$ reduction was observed at 700 MPa HPP levels for 5 min at 25°C and 45°C. Whole camembert cheeses were pressure treated at 600 MPa for 2 min at 25, 35 and 45°C to conduct preliminary quality assessment of Camembert cheese after HPP. The HPP Camembert cheese seemed more dense and firmer in texture. Mold mycelium destruction resulted in loss of white color of the surface of the cheese. No change in flavor was noted. Experiments were conducted on Camembert cheese to determine optimal conditions for the reduction of *L. monocytogenes* after HPP. A $5\log_{10}$ reduction level of Lm was observed on cheese samples pressure treated at 600 to 700 MPa for 2 to 5 min.

Key Words: Listeria Monocytogenes, Soft Cheese, High Pressure Processing

T92 Sensory and instrumental classification among Ragusano P.D.O cheeses of different quality. S. Carpino*[1], I. Caminiti[1], T. Rapisarda[1], and G. Licitra[1,2], [1]*CoRFiLaC, Regione Siciliana*, *Ragusa, Italy*, [2]*D.A.C.P.A. Catania University*, *Catania, Italy*.

Sensory and instrumental profiles of ripened Ragusano cheeses (three to seven months), representing 100 batches produced during the 2006 season, from different farms throughout the P.D.O. production area in Sicily were measured. The current study was undertaken to determine if sensory and instrumental analysis discriminate different qualities, gold quality ($Q \geq 90$) and good quality ($Q < 90$) of the tested cheeses. The cheeses were tested using a MS-based Electronic Nose (EN) and a trained sensory panel. EN data were collected from a head space extraction of volatile organic components from each cheese. An EN was used to detect volatiles in the mass-to-charge (m/z) range of 10 to 160 amu. Statistical analyses on normalized data sets found a group of mid-range masses that efficiently separated cheeses by PCA. Twelve trained panelists tested all the products and QDA was used to describe the cheeses. A quality score (Q) was developed by comparing mean ratings on 14 descriptive attributes with means and standard deviations of 'gold' standard cheeses on the same attributes. Gold quality cheeses ($Q \geq 90$) had significantly lower salt content than good quality ones ($Q < 90$). Gold quality cheeses also had smaller surface holes, weaker in bitterness and bad taste and were more yellow and softer than their good-quality counterparts. Principal components analysis on the EN data separated all cheeses by quality score with an high gold cheeses axis on PC1 (57%) and a separation between good quality cheeses on PC2 (26%). Principal components analysis on the sensory data separated cheeses by quality score with a gold quality cheeses axis on PC1 (23%) and a separation between good quality cheeses on PC2 (16%) confirming the EN results for bitterness, taste, and aroma. Both EN and traditional sensory analysis found similar differences among cheeses. While EN technology is simpler and faster to use, especially if there are a lot of samples, the human perception is probably still superior in detecting subtle differences.

Key Words: Ragusano, Electronic Nose, Sensory analysis

T93 Changes in acidification during cheesemaking in relation to the aroma development of a farmstead cheddar cheese: A preliminary study. M. Almena*[1], P. Kindstedt[1], S. Carpino[2], T. Rapisarda[2], and G. Licitra[2,3], [1]*University of Vermont*, *Burlington*, [2]*CoRFiLaC, Regione Siciliana*, *Ragusa, Italy*, [3]*D.A.C.P.A. Catania University*, *Catania, Italy*.

Among the reasons why farmstead cheeses are greatly appreciated by consumers are: their complex sensory quality, the close link to the environment where the cheese itself is produced, and the cheesemaker ability. Farmstead cheesemakers have to cope with greater changes in milk composition than commodity producers, and often their practices

are only based on experience rather than control processing techniques. However, the importance of controlling pH during cheesemaking is well known, as well as the major effect of pH on textural quality. This study explores how changes in the acidification pattern during cheesemaking affect the aroma development of a farmstead cheddar cheese. Five cheese fabrications were manufactured following 2 different acidification patterns. Two fabrications were made following an acidification pattern with pH values of 6.25 at draining and 5.25 at milling, and three with pH values of 6.40 at draining and 5.30 at milling. After pressing, all cheeses were analyzed for pH, salt and moisture; and after 1-year of ripening, aroma compounds were evaluated using both gas chromatography olfactometry analysis (GCO) and gas chromatography mass spectrometry. Young cheeses had similar physicochemical characteristics, with average values of 5.10 for pH; 35% moisture and 1.65% salt contents. Interestingly, the volatile compounds extracted from all the ripened cheeses were fairly similar, with the significant exception of acetic acid. Acetic acid (sour aroma) was only found on the 3 cheeses using the acidification model with higher pH values, indicating that post-acidification during manufacture occurred. Some of the common volatile compounds in all the samples and the sensory descriptors associated with were: dimethyl sulfide (sulfur/cabbage) – diacetyl (buttery) – thiophene (garlic) – ethyl butyrate (apple) – butanoic acid (cheese/butyric) – methional (potato) and 1-octen-3-one (mushrooms).

Key Words: Acidification Profile, Aroma, Farmstead Cheddar

T94 Texture profile analysis and melting in relation to proteolysis as influenced by aging temperature and cultures in Cheddar cheese. T. C. Rasmussen*[1], D. J. McMahon[1], J. R. Broadbent[1], and C. J. Oberg[2], [1]*Western Dairy Center*, *Logan, UT*, [2]*Weber State University*, *Ogden, UT*.

Changes in cheese physical properties during aging are related to proteolysis by coagulant type, culture enzymes and non-starter lactic acid bacteria. Storage temperature also affects aging rate. Cultures are important for flavor development, but less is understood about their role in melting and textural properties. Our objective was to make Cheddar cheese using different cultures, to age it at 5 and 15 C, and measure physical and proteolytic properties over 12 mo. Cheese was manufactured using Lactococcus lactis starter culture either alone or combined with one or both of lac- Lc. Lactis or Lactobacillus helveticus adjunct cultures. Three replicates of cheese were made using 682 kg milk. Cheese composition was 35.5 ± 1.0% moisture, 52.5 ± 2.5% FDB, 1.65 ± 0.05% salt, and pH 5.2 ± 0.1. All cheeses were initially stored at 5 C, then half moved to 15 C after 21 d. Texture profile analysis was performed using 25% and 60% compression and melting measured using a Meltmeter at 60 C. The data were analyzed based on culture and temperature over 12 mo storage time. The overall hardness decreased, while the cohesiveness decreased for all treatments. Extent of melting was correlated with hardness ($R = 0.62$, $P < 0.0001$), cohesiveness ($R = 0.40$, $P < 0.0001$), and inversely with adhesiveness ($R = 0.24$, $P < 0.0001$). Correlations with adhesiveness and cohesiveness were not linear. Proteins were extracted from cheese at 1 wk, 1, 2, 4, 6, 9 and 12 mo of aging using 0.5 M sodium citrate solution containing 1% NaCl. Purified extracts were then applied to an HPLC C8 reverse phase column and large hydrophobic peptides and protein peaks monitored at 214 nm. Melting was inversely correlated with the amount of intact α_{s1}-casein remaining in the cheese ($R = -0.54$, $P < 0.0001$) and directly correlated with a peak assigned to α_{s1}-casein (f 24 – 199) peptide ($R = 0.56$, $P < 0.0001$).

Key Words: Cheese Ripening, Melting, Proteolysis

T95 Strategies for the manufacture of low fat Cheddar cheese. S. P. Adams*[1], D. J. McMahon[1], J. R. Broadbent[1], S. L. Larsen[1], and M. Drake[2], [1]*Western Dairy Center*, *Logan, UT*, [2]*SouthEast Dairy Foods Research Center*, *Raleigh, NC*.

Common problems with low fat cheeses include lack flavor and hard and rubbery texture. This has limited market growth for low fat cheeses. Our objective was to make interventions that would improve low fat Cheddar cheese quality, by increasing moisture content and altering physicochemical properties. These interventions included, changes to the make-procedure in cooking temperature, increasing pasteurization temperature from 72 C to 85 C to denature whey proteins, homogenizing half the milk at 5.5 MPa to incorporate fat globules into the protein matrix, and pre-acidifying milk to pH 6.3 to reduce calcium content. These modifications were initially studied individually using milled and washed curd techniques. Cheese was made from 160 kg milk standardized to 0.5% fat and a 9-kg block of cheese produced. Cheeses with 52 to 54% moisture and pH 5.15 to 5.25 were preferred, and the inclusion of a cold water curd wash step helped achieve this goal. Higher pasteurization temperature and pre-acidification had beneficial effects but homogenization did not improve cheese appearance or texture. A 2x2 factorial experiment was then undertaken to compare pasteurization temperature and preacidification. Cheeses were stored at 6 C for 1 mo and analyzed by texture profile analysis. Descriptive sensory analysis of flavor was performed after 2 mo using a trained panel. Higher pasteurization temperature significantly increased moisture by 4% and subsequently decreased instrumental hardness ($p = 0.024$) and cohesiveness ($p = 0.001$). Preacidication increased instrumental cohesiveness ($p = 0.002$). No change in meltability was observed between the cheeses. Compared to full fat cheese made with the same cultures, the low fat cheeses had more intense cooked flavor, whey flavor, diacetyl flavor and sulfur flavors. They had less milkfat (lactone) flavor. The cheeses made from milk heated to 85 C had a slight rosy flavor.

Key Words: Low Fat Cheese, Preacidification, Flavor

T96 Prato and Roquefort cheeses from dairy ewes fed with protected fat. R. M. S. Emediato*, E. R. Siqueira, M. M. Stradiotto, M. I. F. B. Gomes, S. A. Maestá, A. Piccinin, E. O. Queiroz, and C. Móri, *São Paulo State University*, *Botucatu, São Paulo, Brazil*.

This trial aimed to evaluate the effect of the milk from Bergamasca ewes fed with inclusion of 3.5% of protected fat in the concentrate on cheese yield, cheese composition, its caloric value and acceptation index of Prato (typical Brazilian cheese) and Roquefort (typical French cheese) cheeses. Seventy seven ewes allocated in 2 groups according to parturition and age: Control (C) and protected fat (PF). Diets were isoenergetic and isonitrogenous, containing 16% CP and 70% TDN on a dry-matter basis. For both treatments it was used the mixed milk production system (lambs housing at night and with its mothers after milking at morning) with one daily milking. Lambs were weaned with

45 days of age. Milked milk was identified and frozen at -15°C for a period of 3-6 months and then used for cheese manufacture. For Prato cheese, each replication has represented milk from each fortnight of the experimental period (60 days) and for Roquefort cheese, each replication has represented milk from the whole experimental period. After cheeses ripening, it was calculated cheese yield and samples were collected for cheese composition and caloric value. Acceptation index was performed with at least 50 people for each cheese. Statistical analysis was performed by means of SAEG 9.0 software. For Prato cheese, treatment C have presented higher protein content and caloric value (26.64 vs 24.60% and 364.52 vs 359.52 Kcal/100g, respectively) and lower fat content (17.82 vs 19.46%) than PF. For Roquefort cheese, treatment PF have presented higher humidity and fat content (49.58 vs 46.83 and 13.40 vs 11.80, respectively) which resulted in higher cheese yield (6.51 vs 7.34 liters of milk/kg of cheese) than C. Both cheeses from both treatments have presented acceptation index higher than 70%, which represented a good acceptation. The fat content in the Roquefort cheese was lower than the usual, which can be explained by lower milk fat content during suckling period than the weaned period (2.25 vs 7.75%, respectively). Mixed Protected fat increases cheese composition and yield without modify its acceptation, which is interesting for cheeses producers and industry.

Key Words: Acceptation Index, Prato, Roquefort

T97 Optical measurement of kinetic changes in curd moisture content and whey fat concentration during syneresis in cheese manufacturing. M. Castillo*[1], C. C. Fagan[2,1], F. A. Payne[1], C. P. O'Donnell[2], and D. J. O'Callaghan[3], [1]*University of Kentucky*, *Lexington*, [2]*University College Dublin*, *Ireland*, [3]*Moorepark, Teagasc*, *Cook, Ireland*.

Syneresis is crucial in cheese making and exerts a tremendous impact on the final quality attributes of cheese. Currently, no technologies are available to control curd moisture content on-line and, as a result, syneresis is empirically controlled. The regulation of curd moisture actually requires control of milk coagulation, cutting time and syneresis. A novel light scatter sensor technology, which is able to monitor milk coagulation and curd syneresis using just one sensor, was used to study the kinetics of changes in curd moisture and whey fat contents induced by curd shrinkage in a stirred, pilot-scale cheese vat. A three-factor, randomized, central composite design (20 runs and three replicates) were used to evaluate the effect of temperature, $CaCl_2$ and cutting time on the kinetics of syneresis. We hypothesized that the varying response of the sensor during syneresis may be a result of curd shrinkage or compositional changes in whey fat content. It has been widely documented that curd shrinkage, whey separation, and fat globules dilution follow a first order kinetic reaction. Thus, the changes in curd moisture and whey fat contents and in the sensor response (R) during syneresis were fitted to first order kinetic equations. The R^2 values between the experimental and fitted data for curd moisture content, whey fat concentration, and R ranged between 0.95-0.97, 0.98-1.00, and 0.87-0.96, respectively. The magnitude of the kinetic rate constants obtained agreed with the existing literature and the rate constants responded consistently to temperature. These results suggest that changes in the variables studied during syneresis followed first order kinetics. Indeed, the optically derived kinetic rate constants were significantly and positively correlated with the kinetic rate constants for changes in curd moisture and whey fat contents. These results clearly show not only the potential of the proposed technology for a comprehensive control of curd moisture content in cheese making but also reveals its potential as a powerful research tool to study coagulation and syneresis.

Key Words: Syneresis, Kinetics, Light Backscatter

T98 Effect of high fat supplements for grazing dairy cows on textural properties of Cheddar cheese. R. Nyoka*, A. R. Hippen, A. N. Hassan, and K. F. Kalscheur, *South Dakota State University*, *Brookings*.

Previous studies showed that grazing on pasture and feeding diets supplemented with fish meal increased the level of conjugated linoleic acid (CLA) and its related isomers in cow's milk. The objective of this study was to determine the effects of such diets on the textural characteristics of Cheddar cheese. The diets of 27 multiparous Holstein (18) and Brown Swiss (9) cows grazing alfalfa/grass pasture were supplemented with partial Total Mixed Rations (pTMR) containing 1) dried distillers grains with solubles (DDG), 2) soybean meal (SB), or 3) fishmeal (FM). Milk was collected from morning milking and stored at 4°C for cheese making the following day. Cheddar cheese was manufactured from pasteurized milk (heated at 63°C for 30 min, and then cooled to 31°C) standardized to casein: fat ratio of 0.78. Moisture, fat, free oil and pH were tested in the fresh Cheddar cheese. No significant differences in moisture, pH and fat on dry matter basis were observed among treatments. Free oil was higher ($P<0.05$) in the DDG (17.78%) and FM (17.59%) cheeses than in the control Soybean cheese (15.78%). Cheese texture, free oil, and pH were monitored during ripening. Texture attributes (hardness, springiness, cohesiveness, gumminess and chewiness) decreased ($P<0.05$) during the first mo of ripening. Whereas, hardness, gumminess and cohesiveness continued to decrease between mo 1 and 3, an increase in chewiness and springiness was observed in all cheeses during this period. There were no significant differences among treatments in all cheese texture attributes. In conclusion, this study shows that diets that increase the level of CLA in milk did not affect cheese texture.

Key Words: High Fat Diets, Cheddar Cheese, Texture

T99 Evaluation of chemical composition of traditional Chinese goat's milk cake. H. Zhang*[2], S. Gokavi[1], C. Maduko[3], Y. Park[3], and M. R. Guo[1], [1]*University of Vermont*, *Burlington*, [2]*Inner Mongolia University*, *Huhott, China*, [3]*Fort Valley State University*, *Fort Valley, GA*.

Goat's milk cake is a fresh cheese-like product, which has been traditionally produced and consumed for centuries in the Southwestern province Yunnan of China. It is made by acidifying the milk using natural acidulant extracted from the leaves and vines of *Marsdenia tenacissima*. Thirteen milk cake samples collected from different households were analyzed for gross composition, mineral content protein and fatty acid profiles. The pH value ranged from 4.08+0.02 to 6.51+0.01, total solids 42.41+0.14 to 52.53+0.10%, fat 19.75+0.32 to 28.40+0.31%, protein 17.93+0.07 to 21.56+0.77%, ash 1.66+0.00 to 2.07+0.04% and lactose 0.91+0.36 to 1.52+0.33%. The average contents of calcium, phosphorous, potassium, magnesium, sodium, zinc and sulphur are 0.58, 0.50, 0.12, 0.03, 0.03, 0.002 and 0.16 g

/100 g, respectively. The major proteins identified by sodium dodecyl sulphate polyacrylamide gel electrophoresis were caseins (35.35+5.44 – 60.37+5.61%), β-lactoglobulin (7.41+1.18 – 10.50+2.13%) and α-lactalbumin (3.65+1.48 – 6.87+1.00%) and their amounts were comparable to those of cow's milk (casein 57.00+6.36%, β -lactoglobulin 10.80+0.42% and α-lactalbumin 6.41+0.44%). Gas chromatography analysis showed that the major fatty acids present in goat's milk cake were butyric acid (C4:0), caproic (C6:0), capric (C10:0), lauric (C12:0) and myristic acid (C14:0). The only unsaturated fatty acid present in significant amount was oleic acid (C18:1) (5.47+0.24 – 12.97+3.32%). Variations in chemical composition of these goat's milk products might due to lack of manufacturing standard, which may require further studies.

Key Words: Goat Milk Cake, Chemical Composition, Protein and Fatty Acid Profiles

T100 Development of cholesterol-reduced Camembert cheese made by crossliked β-CD cyclodextrin. K. H. Seon, E. K. Hong, and H. S. Kwak*, *Sejong University*, *Seoul, Korea*.

The present study was carried out to examine the physicochemical and sensory properties in cholesterol-reduced Camembert cheese made by crosslinked β-cyclodextrin (β-CD). The composition of Camembert cheese treated by crosslinked β-CD was similar to the control and the cholesterol removal reached 90.6%. No significant difference was found in total amount of short-chain free fatty acids between experimental cheese and control at every storage period. The release of butyric and capric acid mostly contributed to the increase of total amount of short-chain free fatty acids in both groups. The cheese made by β-CD-treated cream produced similar amount of individual free amino acids to control in 4 wk ripening period. All rheological properties increased continuously during 4 wk ripening and those were higher in cholesterol-reduced Camembert cheese than those in control. Moldy characteristic in appearance, flavor and taste were increased dramatically through ripening period in both experimental and control cheeses. Based on these results, no profound difference was found in most physicochemical and sensory properties between cholesterol-reduced Camembert cheese and control. Therefore, this study may suggest the possibility to develop the cholesterol-reduced Camembert cheese using crosslinked β-CD.

Key Words: Camembert Cheese, Crosslinked β-CD, Cholesterol Removal

T101 The effect of salt on chemical and sensory attributes in cholesterol-reduced Cheddar cheese made by crosslinked β-cyclodextrin. K. H. Seon, E. K. Hong, and H. S. Kwak*, *Sejong University*, *Seoul, Korea*.

This study was designed to examine the effect of salt on the quality of cholesterol-reduced Cheddar cheese, which was resulted in changes in fatty acids, bitter amino acids and sensory evaluation. The sample cheeses were made by cream separation followed by 10% of crosslinked β-cyclodextrin(β-CD) treatment, and various concentrations of salt added were 1.0, 1.5, 2.0, 2.5 and 3.0%. The samples were tested periodically during 9 week ripening time. In previous study in our lab the ripening time was accelerated extensively in β-CD treated Cheddar cheese making. The cholesterol removal from the cheese was 91.7%. The production of short-chain free fatty acids(SCFFA) increased during ripening. When the contents of salt were added more into the cheese, the amounts of SCFFA significantly decreased during ripening. Higher salt-added cheese produced lower levels of bitter amino acid during ripening. In sensory analysis, the score of bitterness also showed lower levels from higher salt-treated sample. Hardness scores in texture increased during ripening in all samples, however, the levels were lower at higher contents of salt. On the basis of the results, this study suggested that higher levels of salt-treated Cheddar cheese made from crosslinked β-CD improved bitterness and sensory aspects.

Key Words: Cheddar Cheese, Salt, Crosslinked β-Cyclodextrin

T102 The effect of high pressure and low temperature on chemical properties and nutrients in milk. H. Y. Kim, S. A. Maeng, S. H. Kim, and H. S. Kwak*, *Sejong University*, *Seoul, Korea*.

This study was carried out to investigate the effect of pasteurization treated by high pressure and low temperature on chemical properties and nutrients in milk. The factors used were pressure(200MPa), temperature (-4, 4, 12 and 20°C) and time (10, 20 and 30 min). Thiobarbituric acid value(TBA) showed higher at longer time(30 min) and higher temperature(20°C). In the production of short-chain free fatty acid, samples were not different from treated time and low temperatures, however, significantly($P<0.05$) different from high temperatures(12 and 20°C). The productions of free amino acids in the samples were higher than that of control, and they were increased in proportion to treated time and temperature. In the analysis of water-soluble vitamin, L-ascorbic acid, niacin and riboflavin decreased significantly in proportion to treated time and temperature, however, pyridoxine and thiamine did not decrease significantly($P<0.05$). Based on the results of this study, short time and low temperature are effective on properties and nutrient in pasteurized milk treated by high pressure and low temperature.

Key Words: High Pressure, Milk, Vitamin

T103 Microencapsulation of Korean mistletoe extract with polyacylglycerol monostearate. N. C. Kim[1], J. B. Kim[2], J. Ahn[1], and H. S. Kwak*[1], [1]*Sejong University*, *Seoul, Korea*, [2]*Handong Global University*, *Pohang, Korea*.

The present study was carried out to find the optimum conditions for Korean mistletoe extract microencapsulation and its stability in simulated fluids in vitro. As a coating material, polyacylglycerol monostearate (PGMS) was used. Three different conditions were investigated such as the ratio of coating to core materials, amount of distilled water addition and spray pressure. The highest efficiency of microencapsulation was found in the ratio of 15:1 (w/w) as coating to core material. In addition, 40 mL of distilled water addition at 2000 psi spray pressure increased the microencapsulation efficiency up to 78.3%. The shape of microcapsule was spherical and irregular, and the average size was about 30.0Î¼m. In vitro study, only 14.8% of Korean mistletoe extract was released in stimulated-gastric fluid (pH 2) for 60

min incubation. Comparatively, the release of Korean mistletoe extract increased dramatically from 15.8% (0 min) to 83.2% (pH 8) for 60 min incubation in simulated intestinal fluid. Therefore, this study indicated that PGMS cane be used as an effective coating material to microencapsulate Korean mistletoe extract

Key Words: Microencapsulation, Polyacylglycerol Monostearate, Korean Mistletoe Extract

T104 Microencapsulated Korean mistletoe extract for milk fortification. N. C. Kim[1], J. B. Kim[2], J. Ahn[1], and H. S. Kwak*[1], [1]*Sejong University*, *Seoul, Korea*, [2]*Handong Global University*, *Pohang, Korea*.

This study was designed to develop a microencapsulated Korean mistletoe extract that could be used to fortify milk and to determine the sensory properties of milk fortified with microencapsulated Korean mistletoe. Coating material was polyacylglycerol monostearate. The highest efficiency of microencapsulation was 78.3% with 15:1:40 ratio (w/w/v) as coating to core materials to distilled water at 2,000 psi. When microencapsules were added and stored at 5°C for 12 days, 8.3 mg of Korean mistletoe extract was released in 100 mL milk. The TBA value was increased during storage and was significantly lower in capsulated group compared with that in uncapsulated group. In addition, the color values (L, a and b) viscosity were significantly different between capsulated and uncapsulated Korean mistletoe extract added groups when 1 or 2% Korean mistletoe extract added. With 1% microencapsulation addition, most sensory aspects were slightly different between capsulated and control, however, a significant difference was found between capsulated and uncapsulated groups in all storage periods. The present study indicated that the addition of microencapsulated Korean mistletoe extract with PGMS is effective for fortifying milk.

Key Words: Korean Mistletoe, Milk, Microencapsulation

T105 Occurrence of aflatoxin M1 in Manchego cheese. G. Battacone*[1], M. I. Berruga[2], M. Palomba[1], M. P. Molina[3], M. Roman[4], and A. Molina[2], [1]*Università degli Studi di Sassari*, *Sassari, Italy*, [2]*Universidad de Castilla-La Mancha*, *Albacete, Spain*, [3]*Universidad Politécnica de Valencia*, *Valencia, Spain*, [4]*Qualiam*, *Madrid, Spain*.

Manchego is a cured, hard, enzymatically coagulated cheese, made in the four provinces of the Castilla-La Mancha Region (South East Spain) with milk of the Manchega breed ewes. It is the most popular Spanish sheep cheese, produced according to the EU regulation for Guarantee of Origin (POD, 1984), with a total yield of about 8000 Tn per year (44 % of POD Spanish cheeses in 2006). Currently eighty cheese factories are registered in the Council of POD Manchego. A different processing technology is adopted whether the milk has been previously pasteurized or not. In order to guarantee high standard of safety for this internationally recognized product, according to the international regulations about consumer health risks, it is important to investigate the possible occurrence of Aflatoxin M1 contamination. The aim of this work was to determine the level of Aflatoxin M1 contamination in Manchego cheese in a representative sample of cheese factories of the region of Castilla-La Mancha. Two months aged samples of cheese (ready to be sold at the market) from fifty five cheese factories were randomly collected in spring 2006. Chemical composition (fat, protein, salt and moisture) was determined by a FoodScan™ Lab Dairy Analyser (Foss). The immunoaffinity technique was used to extract the Aflatoxin M1 from the cheese samples, and its concentration was determined by HPLC method. The results showed a mean composition of Fat/DM = 51.06±2.2 %; Protein/DM = 39.89±2.6 %. No statistical differences were found among provinces or method of elaboration. All analyzed cheese samples showed Aflatoxin M1 concentrations lower than the detection limit (2.2 ng/kg), suggesting a high safety standard of this dairy product.

Key Words: Aflatoxin M1, Ewe's milk, Cheese

T106 Prediction of fatty acid contents by mid-infrared spectrometry. P. Dardenne[1], F. Dehareng[1], H. Soyeurt*[2,3], and N. Gengler[2,4], [1]*Agricultural Walloon Research Centre, Quality Department*, *Gembloux, Belgium*, [2]*Gembloux Agricultural University, Animal Science Unit*, *Gembloux, Belgium*, [3]*FRIA*, *Brussels, Belgium*, [4]*FNRS*, *Brussels, Belgium*.

The interest for the dairy products with higher nutritional quality increases. The aim of this research was to elaborate different calibration equations to predict by Mid-Infrared Spectrometry the fatty acid contents in bovine milk. 1,609 milk samples were collected between March 2005 and May 2006 for 475 cows from 6 dairy breeds (Dual Purpose Belgian Blue, Holstein, Jersey, Montbeliarde, Normande and Red and White) in 8 herds. 78 samples were chosen using Principal Components approach based on spectral variability. All samples were scanned by MilkoScan FT6000. The reference fatty acid concentrations were measured by gas chromatography with a capillary column of 100 m length. The calibration with Partial Least Squares (PLS) on 78 samples showed a ratio of standard error of cross-validation to standard deviation (RPD) ranged between 1.5 and 6.76. The FA present in high concentration in milk were better predicted as in previous studies. In conclusion, the development of this fast method to predict the FA contents and directly integrating in the milk recording structure gives new perspectives for the dairy industry to detect easily and finally improve nutritional quality of their dairy products.

Key Words: Fatty Acid, Mid-Infrared, Milk

T107 Isolation and characterization of growth factor in goat milk. F. Y. Wu*, M. W. Chien, P. H. Tsao, Y. J. Tsai, Y. C. Lee, and T. Y. Kuo, *National Ilan University*, *I-Lan, Taiwan, ROC*.

Human milk contains various growth factors important for neonatal gastrointestinal tract development. The major growth factor activity in human milk has been identified as epidermal growth factor (EGF). Goat milk also contains growth factor activity. However, the type of growth factor has not been characterized. Further gained knowledge of the growth factor will be useful for developing goat milk-based nutraceutical products. Milk from pregnant does was centrifuged at 3,000 × g for 20 min at 2°C to remove fat and pellet. Casein was precipitated at pH 4.2. The activity, measured by ^{3}H-thymide incorporation in MME cell line, remained in the whey. Growth factor activity was harvested by ammonium sulfate precipitation at 70%

saturation. After dialysis, the sample was ultrafiltrated and separated into different molecular weight fractions with 50, 30 and 3 kDa cutoff membranes. More than 90% activity was present in the >50 kDa fraction, in contrast to the 6 kDa molecular weight of EGF. Subsequently, activity was found within the eluent of 15 to 19ml when gel filtration chromatography was performed by Superdex 200 HR 10/30. Isoelectric focusing using Rotofor cell showed that the activity was in around pH 6.3 fraction, which also differs from the pI 4.6 of EGF. ECL-western blots using different antibodies against various growth factors were performed on all fractions. Since serum albumin, with 67 kDa molecular weight, is also present in the milk extract, blotting results should be carefully interpreted to avoid false positives because some antibodies were generated against antigens conjugated to BSA. Our results showed that the major growth factor in goat milk is different from that of human milk.

Key Words: Growth Factor, Goat Milk, Isolation

T108 Production of conjugated linoleic acid by a mixed commercial culture of L acidophilus, L bulgaricus and S. thermophillus in whole milk. P. Ramírez-Baca*[1,2], E. Escárcega-Padilla[1], S. Torres-Ceniceros[1], J. Meza-Velásquez[1], S. Esparza-González[1], J. Vázquez-Arroyo[1], R. Rodríguez-Martínez[2], and G. V. Nevárez-Moorillon[3], [1]*Universidad Juárez Edo. de Durango*, *Gómez Palacio, Durango, México*, [2]*Universidad Autónoma Agraria Antonio Narro, Unidad Laguna*, *Torreón, Coahuila, México*, [3]*Universidad Autónoma de Chihuahua*, *Chihuahua, Cihuahua, México*.

CLA is a mixture of positional and geometrical linoleic acid isomers with nutritional and health beneficial properties such as being an antiatheroesclerotic, anticarcinogen and antidiabetic agent and an immune system modulator naturally found in food products with fats from animal origin. Since fermented milks have an important role because of its nutritional properties and benefits to digestive tract, the objective of this study was to evaluate CLA production of L acidophilus associated or not with commercial mixed cultures, during milk fermentation. Whole milk was inoculated with L acidophilus alone or L acidophilus associated with S thermophilus and L bulgaricus and incubated at 35°C at four different incubation times. CLA production was measured and data were analyzed by the proc GLM of SAS, considering time and interaction of microorganisms as factors for analysis. Although there was no significative difference (P>0.05) in CLA production, neither by microorganism or time, there is a necessity to continue elucidating the biological mechanisms involved in CLA synthesis with different microorganisms and higher fermentation times.

Key Words: Conjugated Linoleic Acid, L. Acidophilus, Fermented Milk

T109 Poly(L-lactic acid) production from whey permeate. Y. Gao*, F. Zhao, A. Richardson, J. Mendes, D. Savin, and M. Guo, *University of Vermont*, *Burlington*.

The extensive use of commodity plastic products results in serious environmental pollution. Poly(lactic acid) is a biodegradable and biocompatible polymer of lactic acid. In the present study, whey permeate was used as the substrate for poly(lactic acid) production. A mixed culture system including *L. casei* and *L. lactis* was selected based on the ratio of L- to D-lactic acid produced, yield, and productivity from nine homofermentative lactic acid bacterial cultures. After optimization of fermentation conditions, the content of lactic acid is 192 g/L of original broth, the productivity, lactose utilization and purification of L-lactic acid is 4.46 g/Lh, 96.01% and 95%, respectively. The lactic acid recovery process consists of removal of cells and proteins by centrifugation and low molecular weight membrane (<10000 NMWC) separation of the fermentation broth. Decolorization of the product is achieved using 1% activated charcoal stirring overnight. L-lactic acid purification is achieved by extraction of the broth at pH 7 using diethyl ether to remove organic components followed by extraction at pH 2 with the same solvent followed by vacuum evaporation to recover lactic acid. The poly(L-lactic acid) was prepared by using the purified lactic acid with a condensation polymerization process initiated by sulfuric acid. The characterization of poly(L-lactic acid) will be discussed.

Key Words: Poly(lactic acid), Fermentation, Cheese Whey Permeate

T110 Digestion of CLA-enriched milk fatty acids studied in a dynamic *in vitro* gastrointestinal model. R. Gervais*[1], I. Fliss[1], E. E. Kheadr[1], E. R. Farnworth[2], M. R. Van Calsteren[2], C. Champagne[2], and P. Y. Chouinard[1], [1]*Nutraceuticals and Functional Foods Institute (INAF), Université Laval*, *Québec, QC, Canada*, [2]*Agriculture and Agri-food Canada*, *St-Hyacinthe, QC, Canada*.

The objective of the present study was to evaluate the digestibility of fatty acids (FA) from CLA-enriched milk using a dynamic, multicompartmental *in vitro* model (TIM-1; TNO, Zeist, The Netherlands) simulating the human stomach and small bowel. More precisely, the model consisted of 4 compartments simulating the stomach, duodenum, jejunum and ileum. Temperature was maintained at 37° and the pH was monitored and controlled in each compartment. In order to produce CLA-enriched milk, 28 Holstein dairy cows were fed a total mixed ration supplemented with 4% safflower oil. Milk was sampled from each cow and analyzed for milk FA composition. CLA-enriched milk was collected from the cow with the highest CLA content (47 mg/g of fatty acids). Milk was standardized at 3.25% fat, pasteurized, distributed in 300-ml aliquots, and then stored at 4°C until used. Briefly, 300 ml milk was subjected to *in vitro* digestion study using TIM-1 model. Gastric (0.25ml/min), biliary (0.25ml/min) and pancreatic (0.25ml/min) secretions were delivered to the appropriate sections in TIM-1 model through computer-controlled pumps. Ileal delivery of chyme was collected during 360 min of digestion and subjected to FA analysis. Lipid extraction was performed using the Bligh and Dyer method and FA were methylated and analyzed using GLC. Results revealed that the digestibility of total milk FA was 70.2% (SD±3.0). CLA appeared to be highly digestible compared with other long-chain FA of CLA-enriched milk. The TIM-1 model could provide important data regarding the digestibility of FA according to their chain length, degree of saturation, lipid form, or their triglyceride positional distribution.

Table 1. Digestibility coefficients of individual FA of CLA-enriched milk in TIM-1 model (n=2).

FA	%	FA	%	FA	%
10:0	94.2±3.0	18:0	65.4±9.5	*c*11 18:1	65.9±1.5
12:0	83.2±3.1	*t*6-8 18:1	61.8±1.9	*c*12 18:1	65.9±1.2
14:0	72.4±1.7	*t*9 18:1	64.0±2.4	*c*13 18:1	71.7±0.6
*c*9 14:1	79.1±1.9	*t*10 18:1	63.6±4.6	*t*16 18:1	65.5±3.7
15:0	71.2±2.6	*t*11 18:1	64.8±3.6	*c*9,12 18:2	63.1±0.9
16:0	69.7±5.0	*t*12 18:1	63.5±2.0	20:0	66.2±10.9
*c*9 16:1	67.3±0.6	*c*9 18:1	65.5±1.7	*c*9,12,15 18:3	68.7±0.2
17:0	68.8±6.8	*t*15 18:1	73.3±4.4	*c*9*t*11 18:2	80.3±1.0

Key Words: CLA, Fatty Acid Digestibility, TIM-1

T111 Sensory profiles and volatile components of milk protein concentrates and isolates. R. E. Miracle*, J. Childs, and M. A. Drake, *North Carolina State University*, *Raleigh*.

Milk protein concentrates and isolates (MPC, MPI) have been recently utilized in food processing as protein fortifiers. MPC and MPI, unlike whey protein concentrates and isolates (WPC, WPI) contain both casein and whey proteins. MPC have a wide protein content range, 35 to 85 % (w/w), with no standard identity. Characterizing flavor variability of this emerging dried ingredient across the world market is crucial. Identification of distinguishing sensory properties and key volatile flavor compounds is the important first step in learning how the inclusion of milk proteins may affect product flavor. The objective of the current study was to characterize the flavor properties of domestic and international MPC and MPI using sensory and instrumental analyses. Milk proteins (MPC and MPI) were received from commercial facilities in North America and Europe. Products were stored in the dark at 21C, 40% RH and sampled for sensory and instrumental analysis. Milk proteins were rehydrated at 10% solids (w/w) for all analyses. A trained descriptive sensory analysis panel conducted flavor profiling of the rehydrated milk proteins. Instrumental volatiles were extracted by solid phase micro-extraction (SPME) followed by gas chromatography-mass spectrometry. Compounds were identified by comparison of retention indices and GC-MS data against reference standards. Selected compounds were quantified by the construction of standard curves in water. The milk proteins were differentiated by both sensory and instrumental volatile analyses ($p<0.05$). Higher protein products (70-90 % protein) were characterized by tortilla, animal and mushroom flavors while lower protein products (9.6 – 56 % protein) were characterized by sweet aromatic, cereal, and cooked/milky flavors. Principal component analysis of volatile compounds likewise grouped the milk proteins by protein content. As protein content increased, volatile sulfur compounds and aldehyde levels decreased. Flavor properties of MPC and MPI are impacted by protein content and these results will be useful in optimization of processing methods and formulation design.

Key Words: Milk Proteins, Flavor, Milk Protein Concentrates

T112 Characterization of cucumber off-flavor in whey protein concentrate and isolate. J. M. Wright*, R. E. Miracle, and M. A. Drake, *North Carolina State University*, *Raleigh*.

Whey proteins are value-added proteins with multiple ingredient applications. A bland flavor is expected in both whey protein isolate (WPI) and concentrate (WPC). Off-flavors can carry through into ingredient applications and limit the use of these proteins in food products. A cucumber off-flavor was documented in WPI and WPC80. The objectives of this study were to characterize the volatile compounds responsible for this flavor and to document the impact of storage time on the development of this flavor. Additionally, proteins that initially exhibited the off-flavor were agglomerated with lecithin, so both agglomerated and non-agglomerated products were evaluated. Agglomerated and non-agglomerated WPI and WPC80 were collected from suppliers previously noted to develop this off-flavor, stored at 21C, and evaluated every 2 mo through 18 mo storage. At each timepoint, descriptive sensory analysis was conducted on the rehydrated whey proteins to document flavor profiles. Volatile compounds were extracted using solid phase micro extraction (SPME) followed by gas chromatography-mass spectrometry (GC-MS) and gas chromatography-olfactometry (GC-O) to identify and characterize aroma active compounds. Cucumber flavor developed with storage time (average time = 9 mo storage) and products agglomerated with lecithin developed this flavor more quickly than non-agglomerated products. Proteins exhibiting cucumber flavor had more aroma-active volatile compounds characterized as green/vegetative and higher levels of specific aldehydes (ex. hexenal, heptanal, 2,4-nonadienal, 2,4-nonadienal, 2-nonenal) than whey proteins without cucumber flavor. These results suggest that this off-flavor is caused by lipid oxidation and its formation is accelerated by the application of lecithin in the agglomeration process.

Key Words: Whey Proteins, Flavor, Flavor Chemistry

T113 Impact of storage temperature on flavor stability of low heat skim milk powder. R. E. Miracle*, A. E. Croissant, M. A. Lloyd, and M. A. Drake, *North Carolina State University*, *Raleigh*.

Fresh low heat skim milk powder (SMP) should ideally exhibit a mild and bland flavor reminiscent of fluid skim milk. A shelf life of anywhere between 6-36 months for non-instantized unfortified SMP stored at optimal storage conditions has been proposed by various sources. Optimal storage conditions (< 21C and < 50 % relative humidity (RH)) are often not feasible in primary U.S. export countries. The objective of the current study was to evaluate the impact of temperature on storage stability of low heat SMP using instrumental and sensory analyses. Low heat SMP commercially packaged in 3-ply 22 kg bags were received from six commercial facilities on the west coast of the United States within 3 weeks of production on three occasions. SMP were stored in the dark at 21C, 40% RH or 35C, 60% RH and sampled every 3 mo for sensory and instrumental analysis through 36 months. SMP were rehydrated at 10 % solids (w/w) for analysis. A trained descriptive sensory analysis panel conducted flavor profiling of the SMP. Instrumental volatiles were extracted by solid phase microextraction (SPME) followed by gas chromatography-mass spectrometry. Compounds were identified by comparison of retention indices and GC-MS data against reference standards. Selected compounds were quantified by standard addition. Instrumental and sensory profiles were impacted by both storage temperature and storage

time ($p<0.05$). For SMP stored at 21C, cardboard flavor and astringency increased and the concentration of many aldehydes increased while the abundance of maltol decreased with storage time ($p<0.05$). In contrast, similar flavors were detected in SMP stored at 35C along with other flavors: tortilla, burnt feathers, and brothy. Higher concentrations of aldehydes and sulfur compounds were also identified in samples stored at 35C when compared to SMP stored at 21C ($p<0.05$). Sensory and instrumental changes occurred more rapidly in SMP stored at 35C than products stored at 21C ($p<0.05$). Comparison of SMP storage stability at these two temperatures is useful for design of storage regimes and marketing programs.

Key Words: Skim Milk Powder, Flavor, Storage Stability

T114 Fatty acid profile and sn-2 fatty acid distribution of infant milk fat fortified with EPA and DHA. C. O. Maduko[1], Y. W. Park*[2,1], and C. C. Akoh[1], [1]*University of Georgia*, *Athens*, [2]*Fort Valley State University*, *Fort Valley, GA*.

Long chain polyunsaturated fatty acids, arachidonic acids (AA) and docosahexaenoic acid (DHA) contained in human milk have been identified with the proper development and function of the brain. The preferred sn-2 positions for palmitic acid in the triacylglyceride skeleton of human milk fat guarantees maximum fat and calcium absorption. Unlike human milk, vegetable oils as well as cow and goat milks do not contain eicosapentaenoic acid (EPA) and DHA. Vegetable oils contain low amount of AA, and they do not have an appreciable quantity of palmitic acid at the sn-2 position of their triacylglycerides. The objective of this study was to produce modified fat containing similar fatty acid profile and triacylglyceride composition to human milk fat for infant feeding. A blend of 2.1:1.1:0.8:0.4 ratio of coconut oil, safflower oil, soybean oil and menhaden fish oil was enzymatically interesterified with palmitic acid at a 1:1 substrate ratio, using commercial sn-1,3-specific lipase lipozyme RM IM, obtained from Rhyzomucor miehei as a biocatalyst. The mixture was separated by Thin Layer Chromatography (TLC) and the triacyglycerol (TAG) band was assayed for fatty acid content by a gas chromatography. Sn-2 positional determination of the TAG band was done by pancreatic lipase hydrolysis and separation by TLC. Fatty acid profile of the 2-monoacylglyceride band produced was analyzed by GC. The fatty acid profile of the modified fat appeared similar to that of human milk with appreciative quantities of EPA and DHA content. The sn-2 profile of the modified fat had a high percentage incorporation of C16:0, followed by C18:1, which is very similar to the sn-2 profile of human milk. It was concluded that infant milk containing EPA and DHA can be successfully produced by interesterification of palmitic acid using vegetable oil blends fortified with fish oil.

Key Words: Fatty Acid Profile, sn-2 Position, Infant Milk Fat

T115 Impact of agglomeration on the storage stability of whole milk powder. B. J. Wright* and M. A. Drake, *North Carolina State University*, *Raleigh*.

Whole milk powder (WMP) is a common ingredient used in many food products. Agglomeration is commonly applied to WMP to enhance solubility and dispersability. Research has not examined agglomeration effects on flavor and storage stability of WMP. The objective of this study was to determine the effects of agglomeration on the flavor and storage stability of WMP. Unagglomerated WMP (362 kg) was collected from two suppliers and batch-agglomerated with and without lecithin by a commercial agglomerator. The control (non-agglomerated) and agglomerated products were stored at 21C and evaluated every two months through 12 months storage. At each time point, descriptive sensory analysis was conducted on the rehydrated WMP to document flavor profiles. Volatile compounds were extracted using solid phase micro extraction (SPME) followed by gas chromatography-mass spectrometry (GC-MS) and gas chromatography-olfactometry (GC-O) to identify and characterize aroma-active compounds. Physical tests including color, solubility index, peroxide value, and dispersibility were also measured. Initial time zero tests indicated that agglomeration with or without lecithin did not impact flavor, volatile compound profile, or peroxide value of WMP ($p>0.05$). Agglomeration increased dispersability ($p<0.05$). Grassy and painty flavors developed in WMP with increasing storage time concurrently with changes in volatile compound profiles (e.g. increases in aldehydes and alcohols). Sensory and instrumental volatile compound changes occurred more rapidly in agglomerated products compared to non-agglomerated WMP, and these changes occurred more rapidly in WMP agglomerated with lecithin compared to products agglomerated without lecithin ($p<0.05$). These results suggest that agglomeration diminishes shelf stability of WMP and that lecithin further decreases shelf stability by enhancing lipid oxidation.

Key Words: Whole Milk Powder, Agglomeration, Shelf Life

T116 Cloning, expression and antibody production of caprine platelet-activating factor acetylhydrolase. P. H. Tsao*[1,2], T. Y. Kuo[1], J. T. Hsu[2], L. P. Chow[2], and F. Y. Wu[1], [1]*National Ilan University*, *Ilan, Taiwan*, [2]*National Taiwan University*, *Taipei, Taiwan*.

The presence of platelet-activating factor acetylhydrolase (PAH-AH) activity in goat milk (our unpublished data) could be responsible for the anti-inflammatory effect of goat milk as described in the text of ancient Chinese medicine. DNA sequences or amino acid analysis of caprine PAF-AH will be helpful for further study; however, these sequences have not been resolved. Degenerative primers were designed based on the consensus sequence of human, cow, and mouse PAF-AH, for the RT-PCR amplification of PAF-AH mRNA isolated from the buffy coat of goat blood. A full-length PAF-AH DNA, 1.3 kb in size, was generated. Subsequently, translation analysis predicted a 53 kDa protein. The DNA sequence shows 82% and 94% identity to human and cow PAF-AH sequences respectively, while amino acid sequence shows 78% and 92% identity to that of human and cow respectively. Caprine PAF-AH has a distinct N-terminal sequence of 17 amino acids when comparing it to other species. Using *pET24a* vector, a 20 kDa recombinant protein was generated. LC-MS/MS analysis showed a 26.1% coverage with the predicted 20 kDa sequence, indicating the protein was as expected. The recombinant protein was used to immunize rabbit, and using western blot, the anti-serum generated was able to detect both the 20 kDa recombinant protein and a 67 kDa band from the crude extract of goat colostrums, further confirming that the gene cloned was for PAF-AH.

Key Words: Platelet Activating Factor Acetylhydrolase, Caprine, Gene Cloning

T117 Wet distillers grains plus solubles do not alter the relationship between fat content and marbling score in calf-fed steers. A. S. de Mello Junior*, C. R. Calkins, J. M. Hodgen, B. E. Jenschke, and G. E. Erickson, *University of Nebraska*, *Lincoln*.

Some research has suggested feeding dried distillers grain plus solubles can have a negative effect on marbling score in beef. One hypothesis is that feeding this byproduct of ethanol production alters the relationship between lipid content and marbling score by reducing the ability to visualize fat present in the ribeye. The objective of this study was to determine the effects of finishing diets with different levels of wet distillers grains plus solubles (DG) on the relationship between fat and marbling in beef cattle. Ninety-four, calf-fed, crossbred steers were randomly distributed to three treatments (0%, 15% and 30% DG – DM basis) for 133 d. Forty-eight h postmortem, marbling score, marbling texture and marbling distribution were assessed by a USDA grader. For the treatments (0%, 15% and 30%) 37.5%, 62.5% and 46.9% of the carcasses of each respective treatment were considered USDA Choice, with mean marbling scores ($P = 0.456$) of $Slight^{93}$, $Small^{03}$ and $Small^{04}$, respectively. For all treatments, there were linear relationships ($P < 0.008$) between marbling score and fat percentage in the ribeye. Slopes were statistically similar at $P = 0.721$. Treatment did not significantly influence marbling texture, marbling distribution or fat content of the ribeye. These results indicate that finishing diets containing up to 30% wet distillers grains plus solubles can be used without affecting the relationship between fat and marbling in beef.

Key Words: Distillers Grains, Fat, Marbling

T118 Effects of distillers grains finishing diets on fatty acid profiles in beef cattle. A. S. de Mello Junior*, B. E. Jenschke, J. M. Hodgen, G. E. Erickson, T. P. Carr, and C. R. Calkins, *University of Nebraska*, *Lincoln*.

Ninety-four, calf-fed crossbred steers were randomly allocated to three different treatments (0%, 15% or 30% wet distillers grains plus solubles - WDGS – DM basis) and fed for 133 d to test the influence of different levels of WDGS on fatty acid profile in the ribeye. After grading, one ribeye slice (*M. Longissimus thoracis*) about 7 mm thick was excised from each carcass, trimmed and analyzed for fatty acid profile and lipid content. Treatment did not influence the content of total lipid (5.44, 5.91, and 5.94%; $P > 0.187$), unsaturated ($P = 0.762$) and saturated fatty acids ($P = 0.788$). As amount of WDGS in the diet increased (0, 15 and 30%), there were higher concentrations (g per 100 g) of C 18:2 fatty acids (3.27^{b}, 4.22^{a}, and 4.50^{a}, respectively; $P < 0.001$), C 18:2 trans fatty acids (0.003^{b}, 0.011^{b}, 0.034^{a}, respectively; $P < 0.011$), total amount of trans fatty acids in the lean (2.87^{c}, 3.61^{b}, 4.86^{a}, respectively; $P < .001$), conjugated linoleic acid 9*c*, 11*t* (CLA: 0.21^{b}, 0.22^{ab} and 0.27^{a}; $P < 0.041$) and an elevated omega 6:omega 3 ratio (26.72^{c}, 33.64^{b}, and 41.75^{a}; $P < 0.001$) in the lean. Conversely, increasing WDGS in the diet reduced concentrations (g/100 g) of *cis*-vaccenic acid [C 18:1, n7] (3.20^{a}, 2.77^{b} and 2.41^{c}; $P < 0.014$), which has been related to development of off-flavors in beef. The elevated content of polyunsaturated fatty acids could lead to greater oxidation, which could negatively affect color and rancidity. Results from this study demonstrate that inclusion of WDGS in finishing diets can alter the fatty acids profile, which may have negative implications to product quality.

Key Words: Beef, Fatty Acids, Distillers Grains

T119 Influence of complexed trace mineral supplementation on carcass grade and meat quality of broilers processed at 42 and 56 d of age. B. Saenmahayak*, S. F. Bilgili, and J. B. Hess, *Auburn University*, *Auburn, AL*.

A total of 1920 male Ross × Ross 708 broilers were utilized to evaluate the influence of complexed zinc (C-Zn) and manganese (C-Mn) on skin quality and meat quality of broiler chickens at 42 and 56 d of age. Four dietary treatments (60 birds per pen; 8 pens per treatment), consisting of (1) Inorganic Control (80 ppm Zn and 80 ppm Mn), (2) 40 ppm C-Zn [complexed Zn replaced 40 ppm Zn from $ZnSO_4$], (3) 40 ppm C-Zn [complexed Zn provided additional 40 ppm Zn on top of control] and (4) 40 ppm C-Zn + 40 ppm C-Mn [40 ppm complexed Zn and 40 ppm complexed Mn added on top of control] were provided on a four stage feeding program. At 41 d of age, 2 birds per pen were randomly selected to measure skin puncture strength (displacement, load at break point and energy at break point). At 42 and 56 d of age, 10 birds were randomly selected from each pen, processed and chilled in static slush ice. Whole carcass, abdominal fat yields (42 and 56 d), carcass defects (42 d), parts yield (56 d) and deboned breast (fillet and tender) yields (56 d) were also determined. At each age, drip loss (24 and 48 h), cook loss, water holding capacity (WHC) and meat color (L*, a* and b*) were determined on breast fillets. Few differences in live performance were detected throughout the study. Skin puncture strength did not vary ($P>0.05$) between the dietary treatments. Birds on Treatment 3 (40 ppm C-Zn) exhibited significantly lower ($P<0.05$) incidence of sores, scabs and scratches as compared to other treatments. Overall carcass grade, whole carcass and parts yields were not significantly different among the treatments. Breast fillet drip losses and WHC did not show any differences due to treatments at either age. However, at 42 d of age, cook loss was significantly reduced with Treatment 4 as compared to Treatment 1 (22.3% vs. 29.7%). Color measurements at 42 d of age showed highest L* value and lowest a* values with Treatment 1. Response of broiler chickens to complexed trace mineral supplementation was variable and age dependent.

Key Words: Complexed Zinc, Manganese, Skin Quality

T120 Analysis of veal shoulder muscles for chemical attributes. G. A. Sullivan*[1], C. R. Calkins[1], D. D. Johnson[2], and B. G. Sapp[2], [1]*University of Nebraska*, *Lincoln*, [2]*University of Florida*, *Gainesville*.

Veal muscles from the loin, rack and round are being fully utilized using conventional culinary application and therefore sell for a premium; conversely, few applications are commonly applied to shoulder muscles thus causing a lower-value primal. The objective of this study was to characterize the shoulder muscles, using their chemical properties, for the potential to upgrade their value. Twenty

paired veal shoulders from two processors were dissected to isolate nine muscles for the determination of expressible moisture on day 3 and objective color (L*, a*, b*), composition (fat, moisture, ash) and pH on day 13. All traits showed a significant muscle effect ($P < 0.008$). The *M. Supraspinatus* was the lightest colored muscle with an L* of 51.37 ($P = 0.023$). The *M. Serratus ventralis* had the highest fat content at 5.04% ($P = 0.043$) followed by the *M. Complexus* at 4.41% ($P = 0.003$) with the remaining muscles ranging from 2.28-3.26%. The *M. Teres major* was numerically highest in expressible moisture at 39.53% and was significantly different than all but two muscles ($P < .044$). The *M. Infraspinatus* had the highest pH at 5.99 ($P = 0.002$) and the *M. Triceps brachii* and *M. Pectoralis profundus* had a significantly lower pH than the remaining muscles at 5.69 and 5.67, respectively ($P < 0.039$). The *M. Infraspinatus* and *M. Rhomboideus* were statistically superior ($P < 0.050$) in chemical traits compared to muscles with the least desirable values. Conversely, the *M. Pectoralis profundus* was statistically similar to the least desirable value ($P > 0.050$) for expressible moisture, pH and b*. From a chemical profile perspective, all of the muscles possessed some favorable characteristics and in the proper application could be utilized for a value-added muscle.

Key Words: Properties, Quality, Veal

T121 Influence of gender and slaughter weight on growth, carcass characteristics, and meat quality of Duroc and Landrace crossbred pigs. L. L. Lo*[1], C. C. Tsai[1], Y. C. Yang[1], R. S. Lin[2], T. H. Huang[3], and J. Chen[1], [1]*Chinese Culture University*, *Taipei, Taiwan, ROC*, [2]*National ILan University*, *ILan, Taiwan, ROC*, [3]*Taiwan Farm Industry Co., Ltd.*, *Pingtung, Taiwan, ROC*.

One hundred and twenty Duroc and Landrace crossbred pigs were divided into two genders (barrows and gilts) and 5 slaughter weight (85, 95, 105, 115, and 125 kg) to detect the effects of gender and slaughter weight (SW) on growth, carcass and meat quality traits. Pigs were raised under commercial farm condition, and were transported to a commercial slaughter plant when reached the slaughter weight to collect the carcass performance data. Sections of Longissimus muscle (LM) from 9th to last rib were removed and transported to Chinese Culture University for meat quality evaluations. Barrows were grow faster and had shorter days to reach 110 kg of body weight than those of gilts (P<0.05). Gender had no significant effect concerning backfat thickness and saleable lean percentage. LM areas (LMA) of gilts, however, were larger (P<0.05) than that found in barrows (54.33 vs. 51.22 cm^2 , respectively). While no significant differences were detect for subject scores of firmness score, LM from barrows showed higher color (P<0.10) and marbling scores (P<0.05) than in gilts. Significant differences were found for most of the carcass traits between 85 and the other groups of pigs. For most of the carcass traits, slaughter weight larger than 95 and lower than 125 kg were acceptable and showed no differences across groups. Gender showed no difference on most meat quality traits. However, intramuscular fat content was higher in the barrows than in gilts (P<0.01). LM from lighter pigs tended to had more water and less intramuscular fat content (P<0.05). Meat pH, Hunter L value, and water holding capacity were found to not be different across groups. For eating quality, LM from barrows had higher scores on flavour and overall acceptability (P<0.05). No differences were found for sensory evaluation across groups except for lighter pigs had less off-flavor score. Results from this study indicated that LM from barrow had better meat quality and increased SW to 125 kg might have some benefits on marbling and intramuscular fat content.

Key Words: Slaughter Weight, Gender, Meat Quality

T122 Effect of seaweeds on the physical quality and the sensorial characteristics of eggs enriched with omega-3 fatty acids and stored for long time under different conditions. V. H. Ríos[1], S. Carrillo*[1], M. M. Casas[2], M. E. Carranco[1], E. Avila[3], and F. Pérez-Gil[1], [1]*Instituto Nacional de Ciencias Mérdicas y Nutrición Salvador Zubirán*, *México D.F.*, [2]*Centro Interdisciplinario de Ciencias Marinas*, *La Paz, Baja California Sur, Mexico*, [3]*Facultad de Medicina Veterinaria y Zootecnia, UNAM*, *México D.F.*

The aim of this study was to determine if the inclusion of seaweeds in laying hen diets contribute for maintaining the physical quality and the sensorial characteristics of egg enriched with omega-3 fatty acids stored for long time under different conditions. During 8 weeks 144 Leghorn laying hens were distributed in four treatments: T1 (control diet), T2 (2% fish oil+10% M.pyrifera), T3 (2% fish oil+10% Sargassum spp.) and T4 (2% fish oil+10% Enteromorpha spp.). At the end of the trial 122 eggs were taken, which 61 eggs were storage at 20°C and other 61 at 4°C. The egg physical quality was evaluated at 0, 15, 30 and 45 days of storagement; while that the sensorial characteristics of egg (flavor and yolk color) were evaluated by an acceptation test at 0, 15 and 30 days. The results showed a low egg weight loss when the eggs were stored at 4°C (P<0.05), mainly with M.pyrifera and Enteromorpha spp. Time and temperature of storagement did not have any effect on the weight of egg shell. Egg shell thickness did not seem to be affected by time, temperature and seaweeds (P>0.05). Haugh Units were drastically reduced through days (from 0 days until 45 days) when the eggs were stored at 20°C (87 vs 40 UH, respectively). However, when the eggs were stored at 4°C a less reduction was observed (87 vs 63 UH, respectively), mainly with Sargassum spp. and Enteromorpha spp. seaweeds. Egg yolk colour was not affected by time and temperature. The egg flavor was affected on 30 day in all eggs stored at 20°C and 4°C. Treatment with Enteromorpha spp showed a less acceptation for yolk colour at 0 and 15 days because the egg yolk colour was low (8 Roche color Fan). It is concluded that there is a low egg weight loss when Sargassum spp and Enteromorpha spp are included in laying hens diets, similarly, they preserver the Haugh Unit for a long time when eggs are enriched with omega 3 fatty acids.

Key Words: Seaweeds, Egg Physical Quality, Storage

T123 A direct method for fatty acid methyl ester (FAME) synthesis. J. V. O'Fallon, J. R. Busboom, M. L. Nelson*, and C. T. Gaskins, *Washington State University*, *Pullman*.

The objective of this paper was to develop a method to directly synthesize fatty acid methyl esters (FAME) from muscle tissue, oils, and feedstuffs in aqueous solution without prior organic solvent extraction. Wet tissues, or other samples, were permeabilized and hydrolyzed for 1.5 hr at 55°C in 1N KOH in methanol containing C13:0 as internal standard. The KOH was neutralized and the free fatty acids methylated by H_2SO_4 catalysis for 1.5 hr at 55°C.

Hexane was added to the reaction tube, which was vortex-mixed and centrifuged. The hexane is pipetted into a GC vial for subsequent gas chromatography. All reactions were conducted in a single screw cap Pyrex tube. Freeze-dried beef longissimus muscle fatty acids were methylated using sodium methoxide, boron trifluoride and direct FAME synthesis. ANOVA of beef longissimus muscle FAME was calculated using a model with methylation method as the treatments and animal as a blocking factor in a randomized complete block design. When the F-ratio for the methylation methods was significant, Student ′s t-test was used to make pairwise comparisons among the means. Direct FAME synthesis recovered more ($P \leq 0.01$) fatty acids (FA) than did sodium methoxide and much more than did boron trifluoride. Apparently there were fatty acid structures in beef longissimus muscle that were easily methylated by direct FAME synthesis but not by boron trifluoride. When expressed as % FA, sodium methoxide and direct FAME synthesis were quite similar in their results, but boron trifluoride was different ($P \leq 0.01$), and in this latter case (BF_3) the % FA values were higher when the concentration of fatty acid was lower. Direct FAME synthesis consistently methylated more fatty acid, averaging 1.3 times that of sodium methoxide and 2.2 times that of boron trifluoride. The method met a number of criteria for fatty acid analysis including not isomerizing CLA or introducing fatty acid artifacts. Its unique performance, including easy sample preparation, was achieved because water is included in the FAME reaction mixtures rather than eliminated.

Key Words: Fatty Acid Analysis, FAME Synthesis, Longissimus Muscle

T124 Intramuscular tenderness, sensory, and color attributes of two muscles from the *M. Quadriceps femoris* when fabricated using a modified hot boning technique. B. E. Jenschke*, B. J. Swedberg, and C. R. Calkins, *University of Nebraska*, *Lincoln*.

The *M. Quadriceps femoris* from USDA Choice and Select carcasses were fabricated traditionally (**COLD**) or innovatively (**HOT**) in which the seams it shares with the top round and bottom round were separated pre-rigor to test this effect on intramuscular variation in tenderness and color. At harvest, alternating carcass sides were assigned either the HOT or COLD treatment. At 48 h post-harvest, subprimals were removed, vacuum-packaged and aged for an additional 5 d. Following aging, the *M. Rectus femoris* (**REC**) and *M. Vastus lateralis* (**VAL**) were cut into 2.54 cm thick steaks, and allowed to bloom 1 h. For both muscles, L^* values significantly ($P < 0.050$) decreased when moving from the proximal to distal position within the muscle. Similarly, a^* and b^* values decreased in the VAL when moving from the proximal to the distal aspect. Following color measurement, steaks were vacuum-packaged and frozen (-26°C) until shear and sensory data were collected. Significant position (proximal to distal) and location effects (anterior to posterior) were noted for both muscles. For the REC, Warner-Bratzler shear force (**WBSF**) values were not greater than 4.35 kg and all regions were rated slightly tender or better. For USDA Choice REC steaks, the HOT treatment was significantly more tender when compared to COLD treatment. However, treatment did not affect the VAL. For both muscles, a trained sensory panel found a decrease in tenderness moving from the proximal to distal aspect which agrees with WBSF values for both muscles. Additionally, juiciness decreased when moving from the proximal to distal aspect of the VAL that received the HOT treatment. Results from this study indicate that the modified hot boning technique had minimal effects on the tenderness, sensory, and color attributes of the REC and VAL thus making it a feasible fabrication strategy for the industry. Since minimal differences in WBSF and taste panels values between the ball tip portion and the rest of the knuckle were detected, there is little need for value differences between these two portions.

Key Words: Hot Boning, Knuckle, Tenderness

T125 Effect of juvenile clenbuterol exposure on growth in mice. A. C. Dilger*, R. N. Dilger, L. W. Kutzler, and J. Killefer, *University of Illinois*, *Urbana*.

Clenbuterol (clen), a β-2 adrenergic agonist, increases muscle and decreases adipose tissue growth, though it is unclear if clen administration to dams confers similar benefits to offspring. Therefore, our objective was to determine the effect of clen administration to gestating and lactating mice on subsequent growth of their offspring. Clen was administered free choice as 20 ppm of clen HCl mixed in tap water. This study was designed as a 3×2×2 factorial arrangement with main effects of juvenile clenbuterol treatment, adult clen treatment and gender. Juvenile clen treatments consisted of clen administered to dams during the 3 weeks of gestation (GC), clen administered to dams during the 3 weeks of lactation (LC) and no clenbuterol administered to dams (NC). All pups were weaned at 3 weeks of age. At 5 weeks of age, offspring were assigned to adult clen treatment groups - clen or control (no clen) for 2 weeks - and were sacrificed at 7 weeks of age. GC increased 3- and 5-week-old pup weight while LC reduced 3- and 5-week-old pup weight when compared to NC. At 7 weeks of age, pup weight between GC and NC were not different, though both were greater than LC. For all juvenile clen treatments, adult clen treatment increased weight gain from 5 to 7 weeks. However, weight gain was not different between GC and NC pups treated with clen, though both were greater than LC pups treated with clen. Weights of the tibialis anterior (TA) muscle and the combined weight of the soleus and gastrocnemius (SG) muscles were determined. Weight of the TA was increased by adult clen treatment for all juvenile clen treatments. GC TA muscles weighed more than NC which weighed more than LC. Weight of the SG muscles were also increased by adult clen treatment, however, juvenile clen treatment had no effect. These data suggest that LC treatment may reduce growth performance while GC treatment may have beneficial effects. Furthermore, exposure of dams to clen during gestation and lactation does not seem to alter the adult response to clen in their offspring.

Key Words: Clenbuterol, Mouse, Growth

T126 Hematocrit and carcass parameters in broiler chickens submitted to acute heat stress in climatic chamber. E. F. Delgado*[1], C. C. Santos[1], A. C. M. S. Pedreira[2], I. J. Silva[1], and J. F. M. Menten[1], [1]*Escola Superior de Agricultura*, *Piracicaba, São Paulo, Brasil*, [2]*Agência Paulista de Tecnologia do Agronegócio*, *Piracicaba, São Paulo, Brasil*.

Acute heat stress (AHS) occurs in several physiological conditions and may depreciate broiler meat production and quality. The present experiment aimed to simulate in climatic chamber conditions of AHS (35°C; 85% RH) to evaluate the following parameters: hematocrit

(Ht); weight loss (WL, g); carcass weight and yield (CW and CY,%); breast weight and yield (BW, g and BY, %); wing weight (WW), leg weight (LW); visceral weight (VW); and breast free water (BFW, %) of broiler chickens. Animals were slaughtered with 40, 42 or 44 days of age, in three different slaughter times (ST) with average weight of 2.85 Kg (1st ST), 3.00 Kg (2nd ST) and, 3.28 Kg (3rd ST), respectively. In each ST, ten animals were weighed, placed into transport crates (10 by crate) and submitted to AHS conditions for 120 min. Simultaneously, other 10 animals (NS) were evaluated in crates kept in room temperature (22°C). Blood was collected in different times of crate confinement (t0, t30, t60 e t120 min) followed by slaughter. The Ht values showed a decline ($P<0.01$) during crate confinement from 30.0 ±0.4 (t0) to 27.8±0.4 (t120), but there was no effect of AHS. Higher WL ($P<0.01$) and CY ($P=0.078$) were observed for heat stressed broilers (112.0 vs 56.2 and 71 vs 70, respectively). In the 1st ST, there were also higher BW and BY ($P<0.01$) for AHS broilers compared to NS (705 vs 617 and 34 vs 31, respectively). The AHS animals had similar BFW among ST. Within ST, BFW was higher ($P<0.01$) in AHS compared to NS only in the 2nd ST (3.4 vs 2.5, respectively). The BFW in the 1st ST for NS broilers was higher compared to the others ST, and not different from AHS. The Ht reduction would be a preventive measure to avoid hipovolemia that may occur due to WL represented mainly by transpiration. The drainage of water from body tissues during AHS may be concentrated in determined non-carcass tissues and/or groups of skeletal muscle, with a preservation of water in the breast. The AHS can have a detrimental effect in the muscle water distribution.

Key Words: Weight Loss, Carcass Yield, Muscle Water Distribution

T127 Effect of DEX Treatment on Ca^{2+} Content in the satellite cell from broiler muscle. S. G. Wu, Y. Miao, H. J. Zhang, and G. H. Qi*, *Feed Research Institute, Chinese Academy of Agricultural Sciences*, *Beijing, China*.

The effect of glucocorticoid (GC) on Ca^{2+} content of satellite cells (SCs) from broiler muscle was determined to confirm if GC can activise Ca^{2+} signal transmit system in the muscle cells. The SCs were picked up from leg and breast muscle of day-old Abor Acres broilers respectively, and cultured in DMEM culture medium which contained 20% FBS. After 2 day culture, the SCs was marked with Fluo-3/AM. Using laser scanning confocal microscope (LEICA TCS SP2 SE) and highly sensitive Ca^{2+} fluorescent dye, Fluo-3/AM, kinetic changes of Ca^{2+} in single intact living SCs were measured before and after Dexamethasone (DEX) directly treatment. The results showed that intracellular Ca^{2+} content decreased as DEX concentration reduced. The maximum relative values of intracellular Ca^{2+} content of SCs from breast muscle and leg muscle were 144, 80, 63 and 66, 60, 48 for treatment 10^{-4},10^{-5} and 10^{-6} mol/L DEX, respectively. Time for intracellular Ca^{2+}content to reach the maximum relative value increased as DEX concentration reduced; The values for treatment 10^{-4}, 10^{-5}, and 10^{-6} mol/L DEX, SCs from breast muscle and leg muscle were 59s, 130s, 158s and 80s, 98s, and 216s, respectively. More time was needed for intracellular Ca^{2+} content to decrease to the initial level from maximum one; The figures for treatment 10^{-4}, 10^{-5}, and 10^{-6} mol/L DEX, SCs from breast muscle and leg muscle were 542s, 389s, 606s, and 260s, 675s, and 533s, respectively. Compared to the SCs from leg muscle, the SCs from breast muscle were more sensitive to DEX treatment. Treating SCs with DEX at 10^{-4}-10^{-6}mol/L can enhance intracellular Ca^{2+} content. These results indicate that extra cellular DEX can enhance intracellular Ca^{2+} content through active Ca^{2+} signal transmit system in the muscle cells from broilers.

Key Words: Intracellular Ca^{2+}, Dexamethasone, Satellite Cell

T128 Effect of low refrigeration temperature storage on physicochemical properties of packaged shell eggs during retail display. D. K. Shin*[1], C. Narciso-Gaytan[1], M. A. Sartor[1], J. Regenstein[2], and M. X. Sánchez-Plata[1], [1]*Texas A&M University*, *College Station*, [2]*Cornell University*, *Ithaca, NY*.

Approximately 89.9 billion eggs were distributed in the United States, and 86% of the total is table egg. However, most egg quality deterioration reported by egg processing industry is closely related to ″running whites″ and n″flaccid yolks″ during transport and/or retail display. Such deteriorated physicochemical properties of shell eggs may be associated with inadequate handling and/or storage condition. To establish a threshold temperature limit during transport and/or retail display, standard quality parameters and other physicochemical functionalities of shell eggs were evaluated under six different refrigeration temperatures (-1.1, 0.6, 2.2, 3.9, 5.6 and 7.2°C). Three eggs from each temperature were used at days 0, 2, 7, 14, 21 and 28 of storage. As standard quality parameters, Haugh units (HU), yolk index (YI), pHs of albumin (pHA) and yolk (pHY) and vitelline membrane strength were performed. Foaming (CD) and coagulation properties of eggs were also estimated. As expected, HUs was decreased but pHA was increased as storage day increased ($P<0.05$). Additionally, HUs of eggs stored at -1.1, 0.6 and 2.2°C were significantly differed when compared to the eggs under 3.9, 5.6 and 7.2°C of storage temperature and 28 days of storage ($P<0.05$). In conclusion, although storage temperatures below 1°C positively affected some of the quality and functional characteristics of shell eggs, storage temperature around 2°C would match economically.

Key Words: Refrigeration Temperature, Storage, Quality

T129 Isolation and characterization of μ-calpain, m-calpain, and calpastatin from postmortem bovine muscle. I Initial steps. J. P. Camou*, S. W. Mares, J. A. Marchello, R. Vazquez, M. D. Taylor, V. F. Thompson, and D. E Goll, *University of Arizona*, *Tucson*.

The calpains have been suggested to be an important contributor to proteolytic postmortem tenderization. Studies have shown that μ-calpain activity decreases rapidly during postmortem storage, and is nearly zero after 3 d postmortem. Activity of calpastatin, the specific inhibitor of the calpains, also decreases rapidly during postmortem storage, but not as rapidly as activity of μ-calpain does. Activity of m-calpain decreases only slightly during postmortem storage, but it is unclear whether Ca2+ concentrations in postmortem muscle get high enough to activate m-calpain. Hence, μ-calpain has been proposed as the principal contributor to postmortem proteolysis. However, because μ-calpain loses its activity rapidly postmortem, it is not clear how it could be a major contributor to postmortem proteolysis. Therefore, we have initiated attempts to purify μ-calpain, m-calpain, and calpastatin from 10-13-d postmortem bovine muscle. Several properties of postmortem calpains and calpastatin make their purification difficult. 1. Calpastatin is degraded into small fragments, some but not all of

which may have inhibitory activity, so purification of calpastatin from postmortem muscle will require purification of a number of fragments. 2. μ-Calpain is proteolytically inactive, so its purification from postmortem muscle will require detection by antibodies. 3. Because postmortem μ-calpain is autolyzed, it is too hydrophobic to be eluted from phenyl Sepharose columns, and these columns, which are powerful tools in purification of the calpains, cannot be used. We have developed a procedure using a hexyl-TSK hydrophobic interaction column as a first step in purification of the calpains and calpastatin from postmortem muscle. All calpastatin fragments pass straight through this column, and both autolyzed and unautolyzed calpains bind and are eluted quantitatively with 0.1 mM EDTA, 0.1% Brij35. After anion-exchange chromatography, it is possible to isolate two active calpastatin fractions, two μ-calpain fractions, one active and the other inactive, and one m-calpain fraction. Supported by the NIH,NRI,MDA.

Key Words: Calpain, Calpastatin, Postmortem

T130 Sarcomere length dynamics of postmortem ovine *Psoas major* and *Longissimus dorsi* muscles. I. Zapata*[1], T. D. Leeds[2], M. R. Mousel[2], and M. Wick[1], [1]*The Ohio State University*, *Columbus*, [2]*USDA-ARS U.S. Sheep Experiment Station*, *Dubois, ID*.

Understanding the biological mechanisms of postmortem events in muscle is of enormous importance for the meat industry because of their relationship with quality. Because sarcomere length has been previously related to tenderness issues in lambs we decided to study two contrasting types of muscle with known differences in tenderness characteristics. The objective of this study was to compare the sarcomere length (SL) dynamics of postmortem ovine *Psoas major* (PM) and *Longissimus dorsi* (LD) muscles at two time points and to relate LD tenderness to SL. Samples from the PM and LD muscles were removed from 57 animals at 50 min and at 36 h postmortem at the abattoir in the Ohio State University meat science laboratory. Muscle tissue free of evident fat or connective tissue was dissected from each sample and fixed in a glutaraldehyde/cacodylic acid buffer (pH 7.1). Samples were homogenized in cacodylic acid buffer (pH 7.1), mounted on glass slides, observed by phase contrast microscopy and images were captured with a CCD camera. SL were measured using image analysis software. LD chops were assayed at 7 d postmortem for tenderness using Warner-Bratzler sheer (WBS) force. Statistical analysis of the SL was performed using the MIXED procedure and a correlation test with SAS. SL was significantly different from each other within each muscle group and over time ($P < 0.001$). SL least square means estimate for the PM were 2.275 ± 0.023 μm at 50 min and 2.888 ± 0.032 μm at 36 h. SL least square means estimate for LD were 1.835 ± 0.023 μm at 50 min and 1.736 ± 0.016 μm at 36 h. Estimate differences were 0.613 ± 0.040 μm ($P < 0.001$) for PM and -0.098 ± 0.028 μm ($P < 0.001$) for LD. A Pearson′s correlation test showed no relation between LD SL and WBS force at either time point. These results demonstrate inherent differences in the postmortem SL dynamics between the two muscles. That is, the PM exhibited a positive slope in SL during postmortem aging while the LD SL exhibited a negative slope over the same time frame. Currently, the biological mechanism underlying this phenomenon has yet to be elucidated and is actively being pursued in our laboratory.

Key Words: Microscopy, Tenderness, Sarcomere Length

T131 Effect of pig age at slaughter on postmortem muscle protein degradation and fresh pork quality. C. E. Wagner*[1], E. Huff-Lonergan[1], A. A. Sosnicki[2,1], S. B. Jungst[2], and S. M. Lonergan[1], [1]*Iowa State University*, *Ames*, [2]*PIC North America*, *Hendersonville, TN*.

The objective of this study was to investigate if genetic selection of sires for improved growth rate is associated with changes in fresh pork quality. A pig population derived from the cross between a commercial line of Duroc sires and white line dams was subdivided according to the sires' estimated breeding value (EBV) for age at 125 kg. Differences in age at 125 kg were achieved by slaughtering pigs sired by High EBV growth boars (n=48), Low EBV growth boars (n=48) or a control group (n=32). Loin pH and temperature decline were monitored on each carcass. Fresh pork quality characteristics and water holding capacity were monitored at 2 d postmortem. Sensory traits (juiciness, tenderness, chewiness, flavor, and off-flavor) and star probe texture were measured 10 d postmortem. Proteolysis was estimated by desmin degradation and μ-calpain autolysis at 2 d postmortem. Pork quality data were analyzed in a one-way analysis of variance by age at 125 kg. Progeny were divided into groups based on standard deviation from the mean age at 125 kg (165 d) into groups A (142-157 d, mean=149.88 d), B (158-174 d, mean=166.61 d), and C (175-202 d, mean=182.61 d). Loins from pigs in group A had a significantly higher pH at 24 hr and 10 d than groups B and C. Loins from pigs in group A had higher subjective marbling scores and higher lipid content than loins from pigs in groups B and C. Loins from pigs in group C had a higher moisture content than loins from pigs in groups A and B. All groups differed in cook loss, with group A having the most and group C the least amount of cook loss. All groups differed when evaluated for sensory juiciness with loins from group A scoring the lowest and loins from group C the highest. Loins from pigs in group A had lower scores for sensory tenderness than loins from pigs in group C. Loins from pigs in group A had more intact desmin than pigs in groups B and C, as well as a greater amount of autolyzed μ-calpain than pigs in group C. Variation in pork quality could not be attributed to lower pH but could be due to proteolysis differences associated with growth.

Key Words: Growth, Pork Quality, Proteolysis

Forages and Pastures - Livestock and Poultry: Harvested Forages: Fermentation and Nutritive Quality

T132 Effects of concentrate on forage digestion *in vitro*, pH and volatile fatty acids. K. Reed*, D. J. R. Cherney, and J. H. Cherney, *Cornell University*, *Ithaca, NY*.

It is common practice in the dairy industry to use a mixed concentrate and forage diet. The ways in which feeds interact in the rumen at early time points to affect digestion are not characterized. Further understanding of concentrate-forage relationships could aid in the development of a more efficient diet. The objective of this study was to determine the early effects (0-6h) of concentrate type on rumen pH and forage digestion *in vitro*. An initial trial was conducted to compare the effect of buffer strength (full vs. half) on pH change during *in vitro* digestion of orchard grass (*Dactylis glomerata* L.) with or without sucrose. It was determined that using a full strength buffer allowed for sufficient changes in pH for the purposes of this study with the observed pH for the full strength buffer dropping from 6.6 to 5.4. Two forages, orchardgrass and corn (*Zea mays* L.) stover were combined with 5 concentrate treatments (no concentrate, corn meal, corn gluten meal, barley (*Hordeum vulgare* L.) and wheat (*Triticum aestivum* L.) in a 50:50 ration using 0.5 g samples. The samples were incubated *in vitro* in a 1:4 buffer to rumen fluid mixture for 420 min. The pH was measured at 30, 90, 150, 210, 270 and 420 min. Samples were collected at the end of the trial for lactic, propionic, and acetic acid analysis. Samples containing orchardgrass alone had a significantly lower pH ($P<0.05$) than those samples containing concentrate beginning at T=150 min and continuing to 420 min. The corn stover samples were significantly lower in pH ($P<0.01$) at T=270 min which correlates with a high mean lactic acid concentration(535 ppm) compared to the mean lactic acid concentration of the other four corn stover treatments(177 ppm). These preliminary results suggest that a diet containing a mixture of corn and forage minimizes the initial decline in rumen pH in comparison with forage alone, mixed barley and forage, or mixed wheat and forage. Further study to determine differences in the extent of forage digestion in forage-concentrate diets will supply additional information about the effects of mixed rations on rumen digestion.

Key Words: Rumen Digestion, pH, VFAs

T133 Fermentation profile and dry matter recovery of *Panicum maximum* cv. Mombaça silages treated with microbial inoculant at different regrowth ages. E. M. Santos, O. G. Pereira*, and C. L. L. F. Ferreira, *Universidade Federal de Viçosa*, *Viçosa, Minas Gerais, Brasil*.

Dry matter recovery and fermentation profile of *Panicum maximum* cv. Mombaça silages treated with microbial inoculant were evaluated at different regrowth ages. A 4×2 factorial arrangement (four regrowth ages × with or without inoculant) was used in a complete randomized design, with three replicates per treatment. The grass was harvested at 35, 45, 55 and 65 days of regrowth and ensiled in 20-l buckets, with or without the inoculant Sil-All C4 (Alltech, Brazil). Ammonium nitrogen/total nitrogen ratio ($N\text{-}NH_3$), pH and volatile fatty acids profile (lactic, acetic and butyric acids) were determined in the silage aqueous extract. Silage dry matter recovery was also calculated. The pH decreased by 0.0037 and 0.0041 units per regrowth day in silages without and with inoculant, respectively. Independently of the age, the lowest pH and $N\text{-}NH_3$ values ($P<0.05$) were recorded for the silages that were inoculated. Lactic acid increased linearly ($P<0.05$) with regrowth age, whereas acetic and butyric acids decreased. Lower values of acetic and butyric acids ($P<0.05$) were recorded for inoculated silages at all the ages. Levels of lactic acid increased ($P>0.05$) with inoculant addition except for the age of 65 days, at which there was no difference ($P>0.05$). Dry matter recovery increased linearly ($P>0.05$) with regrowth age, with greatest values ($P<0.05$) recorded for inoculated silages. The microbial inoculant improved the fermentation profile in silages of *Panicum maximum* cv. Mombaça plants harvested up to 55 days of regrowth.

Financial support by FAPEMIG

Key Words: Acetic Acid, Butiric Acid, Lactic Acid

T134 Microbial populations and fermentation profile of signalgrass (*Brachiaria decumbens* Stapf) silages harvested at different regrowth ages. E. M. Santos, O. G. Pereira*, C. L. L. F. Ferreira, and R. Garcia, *Universidade Federal de Viçosa*, *Viçosa, Minas Gerais, Brasil*.

Microbial populations, pH, ammonium nitrogen/total nitrogen ratio ($N\text{-}NH_3$) and volatile fatty acid concentration were evaluated in signalgrass silages produced from plants harvested at different regrowth ages (30, 40, 50, 60 and 70 days), being ensiled into 2-Kg laboratory silos. A 5×6 factorial arrangement (5 regrowth ages × 6 fermentation periods) was used in a complete randomized design, with three replicates. The fermentation periods were 1, 3, 7,14, 28 and 56 days. Lactic acid bacteria (LAB) populations ranging from 3.93 to 5.51 log colony-forming units (CFU)/g of fresh forage were detected. Maximum populations of these microorganisms were found in the silages on the seventh fermentation day (8.69 log CFU/g silage). Enterobacterium populations persisted up to the twenty-eighth fermentation day, with maximum values being found at the first day (7.89 log CFU/g silage). $N\text{-}NH_3$ content decreased linearly ($P<0.05$) with the regrowth age, whereas it increased linearly ($P<0.05$) with the fermentation period. The pH decreased exponentially ($P<0.05$) as fermentation period increased, reducing from 4.95 to 4.29, from the first to the last age, at the end fermentation period. The contents of lactic acid increased, whereas the butyric acid decreased linearly ($P<0.05$) with the regrowth age. However, the content of both acids increased linearly ($P<0.05$) as the fermentation period increased, with ratios of 0.031, 0.012 and 0.003 units per day of fermentation, for lactic, acetic and butyric acids respectively. Signalgrass plants harvested from the 50^{th} day had adequate LAB populations which guarantees good fermentation, resulting in a good quality silage, considering pH, NH_3 and organic acid values.

Financial support by FAPEMIG

Key Words: Enterobacter, Lactic Acid Bacteria, Volatile Fatty Acid

T135 Silage inoculant effects on *in vitro* rumen fermentation. R. E. Muck[1], F. E. Contreras*[2], and D. R. Mertens[1], [1]*USDA-ARS, Dairy Forage Research Center*, *Madison, WI*, [2]*University of Wisconsin-Madison*, *Madison*.

Four inoculants, B (*Lactobacillus plantarum* and *Enterococcus faecium*), C (*Lactobacillus plantarum*), D (*Lactobacillus pentosus*), E (*Lactococcus lactis*), were compared with an uninoculated treatment (A) on alfalfa (38% DM, AS), corn (36% DM, CS), and brown midrib corn (33% DM, BMR) silages. All inoculants were applied at 105 CFU/g forage. Four 1-L jars were ensiled of each treatment. Silages were analyzed for fermentation characteristics. Additionally, 100 g from each silo were wet ground (2 to 5 mm) and frozen (-20°4C) until used for *in vitro* incubations. Two *in vitro* rumen fermentations were conducted per each treatment and crop. For each run, 1.0 g wet-ground silage from each silo was placed in a 160 mL serum bottle. Buffer (17 mL) and inoculum (12 mL) were added to each bottle. The bottles were sealed with butyl rubber stoppers and crimps and incubated at 39°C. Gas pressure was measured at 3, 6, 9, 24, and 48 h. At 9 and 48 h each treatment was analyzed for microbial biomass yield (MBY) and volatile fatty acids (VFA). Silage pH and lactic acid concentration were not affected by treatment across three trials. Silage pH was higher on AS (4.60) than CS (3.84) and BMR (3.89). Lactic acid concentration was similar between AS (74 g/kg DM) and BMR (73), but greater than CS (45). At 9 h incubation, gas and VFA production were different among crops ($P < 0.05$) but not among treatments ($P > 0.05$). However, MBY differed across treatment and crop. MBY in CS was similar to AS and greater than BMR (39.5, 39.3 and 32.7 mg/100 mg truly digested (TD) respectively). Among inoculants, C, D, and E (37.9, 39.0, and 38.0 mg/100 mg TD respectively) were similar and greater than A and B (35.4 and 35.5 mg/100 mg TD respectively). Similar trends in MBY were observed at 48 hr incubation. We conclude that the biggest impact of silage microbial inoculants on *in vitro* rumen fermentation was increasing microbial biomass yield, but this effect was not equal across all microbial inoculants.

Key Words: Silage Inoculants, Gas and Microbial Yield

T136 Enzyme and bacterial inoculant effects on hybrid corn (Zea mays) silage composition. O. Ruiz-Barrera*[1], Y. Castillo[1], C. Rodriguez[1], O. La O[2], R. Beltran[1], and C. Arzola[1], [1]*Facultad de Zootecnia*, *Chihuahua, Chih., Mexico*, [2]*Instituto de Ciencia Animal*, *La Habana, Cuba*.

Treating silages with fibrolytic enzymes and bacterial inoculants has been shown to improve digestibility, fermentation and aerobic stability of a variety of forages. The objective of this experiment was to evaluate the effects of three additives on chemical composition and fermentation characteristics of silage from seven different corn (Zea mays) hybrids: DK641™, Eagle 238W™, Golden Harvest EX313™, Golden Harvest H9403,™, Pioneer 32R25™, Pioneer 31G98™, and Producers 725™. Corn plants were planted in 14 experimental plots (1 ha each, replicated once) in Bachiniva, Chihuahua, Mexico and harvested at stage of maturity of 1/3 of milkline. Whole corn plants were cut and subsamples were chopped and ensiled in mini silos (1.3±0.1 kg and 4 minisilos per treatment) for 42 d. Treatments were control: CT 20 ml distilled water); SA (0.0065 g Sil All™ 4×4 L. plantarum, P. acidilactii, E. faecium, and B. salivarus); BS (0.182 g Bio-sile™ L. plantarum and P. pentosaceus) and FB 0.31 g Fibrozyme™(xylanases and T. viride). Silage corn samples were analyzed for dry matter (DM), crude protein (CP), neutral detergent fiber (NDF), acid detergent fiber (ADF), cellulose (CE), hemicellulose (HE), in vitro dry matter digestibility (IVDMD), in vitro organic matter digestibility (IVOMD), pH and lactic acid (LA). Inoculation with SA and BS increased content of NDF of silage of corn hybrids 31G98 and DK641 ($P<0.05$). Addition of SA increased CP of corn silages from H9403, 238W and EX313 ($P<0.05$). However, FB decreased NDF concentration of 31G98, H9403 and 238W, lowered pH of DK641 and EX313 and increased concentration of LA content of EX313 and increased concentration of LA content of EX313 ($P<0.05$). No effect on DM and OM digestibility was observed for FB, but when BS and SA were added a significant difference ($P<0.05$) was observed for the hybrids DK641, 32R25 and Producers 725. These show that when applied at ensiling certain inoculants and fibrolytic enzymes can improve various chemical characteristics of corn silage hybrids, however, effects vary depending of the particular corn hybrid.

Key Words: Silage, Fermentation, Additives

T137 Use of solid state fermentation to increase nutritious value of apple byproducts. C. Rodríguez-Muela*[1], A. Becerra[2], O. Ruiz[1], A. Ramírez[1], A. Flores[1], and A. Elías[3], [1]*Universidad Autónoma de Chihuahua*, *Chihuahua, México*, [2]*Universidad Autónoma de Nayarit*, *Tepic, México*, [3]*Instituto de Ciencia Animal*, *La Habana, Cuba*.

To improve nutritious value of apple byproducts (AP) by solid state fermentation (SSF), two experiments were carried out. In experiment I, a complete random 2 × 3 factorial design with two urea levels (UR; 1.5 and 2.0%) and three ground corn levels (GC; 0, 10 and 20%) added to AP was used. In experiment II, a complete random 4 × 3 factorial design was used in an AP mix, with four times (0, 24, 48 and 72 h) of repose before fermentation (RT), with 0, 10 and 20% of GC. In experiment I, an interaction ($P<0.05$) on crude protein (CP) and on true protein (TP) between UR and GC was detected, where protein contents diminished as higher levels of GC were added to the mix. A greater ($P<0.05$) optic density (OD) of yeasts with 1.5% (10.6 UFC*1000) Vs 2% (7.3 UFC*1000) of UR was observed. Organic matter digestibility (OMD) increased as UR was increased ($P<0.01$; 62.2% and 73.4% for 1.5 and 2%, respectively) in the mixture. The urea level did not affect ($P>0.05$) NDF, but ADF values increased ($P<0.05$) from 36.5 to 42.9% with 1.5 and 2% of urea, respectively. The OD decreased ($P<0.01$) as the level of GC increased (12.9, 7.5 and 6.5 UFC*1000 for 0, 10 and 20% of GC, respectively). The OMD was improved ($P < 0.01$) with the addition of GC (58.7, 65 and 68.3% for 0, 10 and 20% of GC). The NDF decreased ($P<0.01$) with the level of GC added to the mixture (64.5, 55.5 and 47.4% for 0, 10 and 20% of GC, respectively). Also, ADF decreased ($P<0.01$) when GC was increased (53.2, 35.2 and 30.7% for the 0, 10 and 20% levels of GC). In experiment II, NDF was lower ($P<0.01$) for the 72 h (46.2%) than 24, 48 and 96 h of RT (53.8, 51.5 and 53.1%, respectively). As GC was added to the mixture NDF decreased (59.0, 52.3 and 42.0% for 0, 10 and 20% of GC; $P<0.01$). In conclusion, urea added to apple byproducts increased crude protein and true protein values during the solid state fermentation, if ground corn is not added to apple byproducts; however, as ground corn was increased, true protein content was reduced and the organic matter digestibility was improved.

Key Words: Apple Byproducts, True Protein, Fermentation

T138 Protein production by solid state fermentation of apple waste and pomace. H. E. Rodríguez-Ramírez*, C. Hernández-Gómez, C. Rodríguez-Muela, O. Ruíz-Barrera, and F. Salvador-Torres, *Universidad Autónoma de Chihuahua*, *Chihuahua, Chihuahua, México*.

In order to evaluate protein production by solid state fermentation (SSF) of apple waste (AW), apple pomace (AP) and their combinations, four treatments (t): t1 (100% AP, n=6); t2 (33.4% AW and 66.4% AP, n=6); t3 (66.6% AW and 33.4% AP, n=6) and t4 (100% AW, n=5) were evaluated. The mixtures were added with urea (1.5%), minerals (0.5%) and ammonium sulfate (0.4%). They were fermented at 32°C during 6 days (d0, d1, d2, d3, d4 and d5) in an incubator, and were mixed thoroughly every 4 h. On d5 temperature was incremented to 60 ammonium sulfate (0.4%). They were fermented at 32°C to dry the mixtures. This was considered the final product (d6). The variables measured were temperature (T, d0 to d3), pH (d1 to d5), yeast count (YC, d0 to d5), true protein on dry matter basis (TPDM, on d0 and d6) and dry matter (DM, on d0 and d5). Data were analyzed by ANOVA, using treatment, day and their interaction as main effects, on GLM procedure of MINITAB 13. T showed increment (P<0.01) on t1 (from 12.2 to 35.2°C) and t2 (from 16.0 to 36.7°C) during d0 and d1, these were higher than t3 and t4 increment (from 15.2 to 29.5°C and from 16.0 to 26.4°C, respectively). After this moment all treatments showed T close to 29.5°C. pH showed an increment (P<0.01) from d1 to d3 on t1 (d1=3.3, d3=5.2), t2 (d1=3.2, d3=6.5) and t3 (d1=3.6, d3=5.5); t4 showed a different behavior (d1=4.0, d3=3.3, d5=5.0) where the pH first decreased from d1 to d3 and after it was increased from d3 to d5. YC showed an increment (P<0.01) on all treatments. t1 had the highest increment (d0=11.0*10^6 Ucf/ml to d5=293.0*10^6 Ucf/ml), and the lowest increment was for t4 (d0=2.7*10^6 Ucf/ml to d5=83.2*10^6 Ucf/ml). TPDM had a sustained increment (P<0.01) from 4.0% (d0) to 19.6% (d6). TPDM means by treatment at d6 were 15.5, 19.3, 23.2 and 20.5% for t1, t2, t3 and t4 (P>0.05) respectively; DM showed differences (P<0.01) at d5 (t1=69.3%, t2=82.5%, t3=71.4% and t4=44.3%). We concluded that AW is more efficient for TPDM production; AW had the lower YC with high final protein content. Microbial population was responsible of the different T and pH differences between byproducts.

Key Words: Apple, Fermentation, Protein

T139 Temperature, dry matter, pH, yeast count and protein behavior on the solid state fermentation of apple pomace. C. Hernández-Gómez*, H. E. Rodríguez-Ramírez, C. Rodríguez-Muela, A. Flores-Mariñelarena, and C. Arzola-Alvarez, *Universidad Autónoma de Chihuahua*, *Chihuahua, México*.

In order to evaluate the behavior of temperature (T), dry matter (DM), pH, yeast count (YC), crude protein (CP) and true protein (TP) during the first 7 days by solid state fermentation (SSF) of apple pomace (AP); there were prepared 3 mixtures with 2,780, 3,480 and 3,500 kg of AP (M1, M2 and M3, on October 6, October 18 and October 25 of 2006 respectively). There were added 1.5% of urea, 0.5% of a mineral supplement and 0.4% of ammonium sulfate, wet basis. The temperature and samples to determine DM (at 100º C), pH, CC (cell count on Neubauer chamber), CP and TP were taken daily during 7 days (d0, d1, d2, d3, d4, d5, and d6); data were analyzed by ANOVA on MINITAB 13. The main factors were mixture and day. There were not differences (P>0.05) between mixtures or days for T: M1 (28.34), M2 (25.19), M3 (30.10) and DM: M1 (22.34), M2 (23.06), M3 (26.70). M1 had a pH average of 5.48 and was lower (P<0.01) than M2 and M3 (6.80 and 8.41 respectively). pH was incremented daily (P<0.01) from 4.45 (d0) to 10.16 (d6). YC showed difference (P<0.05) between mixture and day. The lower YC was for M1 (10.07*10^6 Ucf/ml), M2 (30.55*10^6 Ucf/ml) and M3 (46.73*10^6 Ucf/ml). YC on d0 was 20.23*10^6 Ucf/ml and on d6 was 51.29*10^6 Ucf/ml. CP was lower for M1 (P<0.05) than M2 and M3 with values of 24.53%, 32.87% and 32.14% respectively. TP did not show difference (P>0.10) between mixtures. There was an increment (P<0.10) of TP from d0 (13.43%) to d6 (19.12%). We conclude that solid state fermentation increment the protein content of AP. pH is changed from acid to basic trough the time and yeast quantity is incremented, but this can be distinct between mixtures. The behavior of temperature and dry matter is similar between mixtures trough time.

Key Words: Apple Pomace, Fermentation, True Protein

T140 Effect of fibrolytic enzymes and an inoculant on in vitro digestibility and gas production of low-dry matter alfalfa silage. L. K. Kozelov[1], F. Iliev[1], A. N. Hristov*[2], S. Zaman[2], and T. A. McAllister[3], [1]*Institute of Animal Sciences*, *Kostinbrod, Bulgaria*, [2]*University of Idaho*, *Moscow*, [3]*Agriculture and Agri-Food Canada*, *Lethbridge, AB, Canada*.

The objective of this study was to investigate the effect of polysaccharide-degrading enzymes (a cellulase and a xylanase) alone or in a combination with a bacterial inoculant on fermentation parameters and *in vitro* degradability and gas production of low-DM alfalfa silage. First cut alfalfa (*Medicago sativa* L.), harvested at about 5% bloom stage (260 g/kg DM) was ensiled in laboratory-scale silos. Treatments were: control (water); formic acid (FA), 4 L/t fresh silage; a cellulase enzyme preparation (Cell) applied at 5 kg/t silage; a xylanase (Xyl) applied at 5 kg/t silage; a mix of Cell and Xyl, 2.5 kg/t silage of each enzyme; a lactic acid bacteria-based inoculant (Inoc) applied at a rate providing 1.0×10^5 cfu per gram of silage; and a mix of Cell (5 kg/t silage) and Inoc (1.0×10^5 cfu per gram of silage) (Inoc/Cell). Triplicate silos were open on d 3, 7, 15, and 60. The FA silage maintained the lowest pH through d 60 (5.21; $P < 0.05$). The inoculant- and Inoc/Cell-treated silages had lower ($P < 0.05$) pH than the control silage on d 7 and 60. Ammonia N and total free amino acids concentrations (23 and 158 g/kg silage N) were the lowest ($P < 0.05$) for the FA silage. *In vitro* degradability of silage DM was not affected ($P = 0.998$) by treatment. Compared with the control (51.3 ml/100 mg silage DM), most treatments increased ($P < 0.001$) the 24-h cumulative gas production; Inoc/Cell (65.1), Cell (64.0), Inoc (63.4), Xyl (61.7), and FA (61.6 ml/100 mg). Overall, enzyme- and lactic acid bacteria-based preparations had minor effects on silage fermentation in this experiment. The increased cumulative gas production indicates some preservation of fermentable organic matter with most treatments. This effect, however, is unlikely to trigger corresponding response in ruminal digestibility *in vivo*.

Key Words: Alfalfa Silage, Exogenous Enzyme, Microbial Inoculant

T141 The use of bacterial silage inoculants to ensile crushed corn grains and its effects on ensilability and aerobic stability. G. Böck[1], K. Schöndorfer[2], Y. Acosta Aragón*[1], A. Klimitsch[1], and G. Schatzmayr[1], [1]*BIOMIN Research Center*, *Tulln, Austria*, [2]*University of Applied Sciences*, *Krems, Austria*.

The primary purpose of ensiling is the conservation of forage and crops for feed. To improve feed quality of silages especially to inhibit growth of *Clostridia*, yeasts and moulds and their production of toxins chemical and biological silage additives are used. In contrast to chemicals the usage of lactic acid bacteria (LAB) poses a natural, non-corrosive and cheaper alternative to chemicals. The objective of this experiment was to study novel mixtures of homofermentative and heterofermentative LAB under laboratory conditions. The ensiling trial was performed with crushed corn grains using product 1 and 2 at a dosage of 1×10^6 CFU/g of raw material. A control was compared to product 1 (*Lactobacillus kefiri* and *Lactobacillus brevis*), product 2 (*Enterococcus faecium*, *Lactobacillus plantarum*, *Lactobacillus kefiri* and *Lactobacillus brevis*), Chemical A (2.5 l/ton) and a product consisting of *Lactobacillus rhamnosus*, *Lactobacillus plantarum* and *Lactobacillus buchneri* (product 3). Three silos per treatment were opened after 2, 7, 47 and 90 days of ensiling. The following parameters were analysed: pH, sugars and organic acids (HPLC), aerobic instability and dry matter (DM) loss. As expected product 1 showed the highest DM loss after 90 days (1.42 %) followed by product 3 (1.32 %) and the control (1.14 %). Product 2 showed smaller DM losses than the control. Chemical A showed the lowest DM loss with 0.81 %. The differences in pH decrease were very small among all groups. Lactic acid fermentation was fastest in the group with product 2 and slowest in the group with product 3. Acetic acid is most abundant in the group with product 1, followed by the group with product 2. However, acetic acid content is very low in all groups ranging between 3.16 and 14.82 g/kg DM. Aerobic stability was excellent after both 47 and 91 days for all trial groups except the control, which showed instability after 5.8 and 8.5 days, respectively.

Key Words: Silage Inoculant, Corn, Aerobic Stability

T142 Liquid urea by product as an additive to improve intake and digestibility of grass hay. J. L. Rodríguez-Rivera*, E. Valencia, and A. A. Rodríguez, *University of Puerto Rico, Mayaguez Campus*, *Mayaguez, Puerto Rico*.

This experiment evaluated the effect of applying liquid urea (LU; 16% N) on the nutritive value of old world bluestem hay (GH; Dichanthium annulatum). Four male rams (31 kg) were fed during four consecutive periods with chopped GH mixed with one of four rates of LU [0 (T1), 0.2 (T2), 0.4 (T3) and 0.6% (T4), (DM basis; wt/v)]. Experimental diets were offered at 3% of expected dry mater intake based on animal body weight. In each period, the LU was diluted with 600 ml of distilled water and sprayed to the GH 24-h before feeding. For each experimental period, there was a 5 d diet adaptation and 5 d of data collection. GH on offer, orts, and feces were measured daily for each ram. GH offered, refused and 10% aliquots of feces collected in bags were used to determine GH intake (GHI) and GH digestibility (GHD). Data were analyzed using the GLM procedure of SAS in a randomized complete design and means separated with Bonferroni t-test. Crude protein concentration increased with increasing rates of LU (2.26, 2.92, 5.49 and, 6.35% for T1, T2, T3 and T4, respectively. GHI with T3 (1160 g/d) was higher (P<0.05) than for T4 (1046 g/d), T1 (1026 g/d) and T2 (987 g/d). However, GHD was similar (P=0.05) for all LU rates. In summary, LU is a potential feed additive to improve the nutritive value of old world bluestem hay. Results indicate that LU-carbohydrate source combination studies are needed.

Key Words: Liquid Urea, Rams, Grass Hay Intake

T143 Effects of irrigation system and level of water on corn silage hybrid NDF digestibility in northern Italy. E. Raffrenato[1], A. Formigoni[2], I. Fusaro*[3], A. Palmonari[2], N. Brogna[2], M. E. Van Amburgh[1], and C. J. Sniffen[4], [1]*Cornell University*, *Ithaca, NY*, [2]*DIMORFIPA, Università di Bologna*, *Ozzano dell'Emilia, BO, Italy*, [3]*Dipartimento di Scienze degli Alimenti, Università di Teramo*, *Teramo, Italy*, [4]*Fencrest, LLC.*, *Holderness, NH*.

Increasing temperature and light with excess water has been shown to increase lignification and reduce digestibility. The objectives of this study were to assess the effects of two irrigation systems, flood (F) or sprinkler (S), and two application levels on in vitro NDF digestibility (IVNDFd) of three hybrid corn silages. Three hybrids selected to have different digestibility were provided by the Long Island Cauliflower Association (NY) and were grown in summer 2006 under similar conditions in the Po Valley, Italy. Irrigation was applied at two levels of water, low (FL and SL) and high (FH and SH), as a randomized block with a split-plot treatment and three replicates. Nitrogen was applied as urea at 350 kg per ha. The forages were harvested at 30-32% DM and ensiled in mini silos. Silages were analyzed for chemical composition and IVNDFd. There were no effects of hybrid, so hybrids were pooled by irrigation method and level. Starch and NDF content were not different by irrigation method, however, F irrigation resulted in lower CP, greater ADL, and reduced IVNDFd and rate of NDF digestion ($P < 0.05$, Table 1). These results demonstrate that excess water decreased forage nutritional values, inconsistent with the differences expected by hybrid. Thus, irrigation strategies may aid in optimizing forage quality.

Table 1. Least Squares Means

Irrigation*	FL	FH	SL	SH	se
CP, %DM	6.23^{b}	6.08^{b}	7.41^{a}	7.39^{a}	0.11
Sol. Prot., %DM	3.10^{a}	3.02^{b}	3.62^{a}	3.80^{a}	0.04
Starch, %DM	27.99^{a}	27.07^{a}	29.32^{a}	29.97^{a}	1.83
ADF, %DM	26.71^{a}	27.32^{a}	21.83^{b}	24.32^{ab}	1.46
ADL, %DM	3.49^{a}	3.54^{a}	2.55^{b}	2.95^{ab}	0.24
NDF, %DM	45.94^{a}	44.87^{a}	42.59^{a}	41.34^{a}	1.91
24h IVNDFd, %DM	48.98^{c}	49.10^{c}	56.91^{a}	53.47^{b}	1.49
Kd, %/hr	4.39^{b}	4.41^{b}	5.26^{a}	5.41^{a}	0.13

* Values within rows with different superscripts differ ($P < 0.05$).

Key Words: Corn Silage, Irrigation, Neutral Detergent Fiber Digestibility

T144 Utilization of silage of *Albizia lebbeck* as supplement of sheep. F. Fernández, T. Clavero*, R. Razz, and O. Araujo-Febres, *Facultad de Agronomia, Universidad del Zulia*, *Maracaibo, Zulia, Venezuela*.

Diets with silage of *Albizia lebbeck* were fed to sheep with the objetive to study daily intake and nitrogen metabolism. Sixteen confined west african sheep were offered with different levels of supplementation of silage in a region characteristics as dry tropical forest at north west of Venezuela. The rations used were 100% *Brachiaria humidicola* hay (HBH); 75%HBH + 25% silage *A. lebbeck*; 50% HBH + 50% silage *A. lebbeck* and 25% HBH + 75% silage *A. lebbeck*. Individual animals were housed in a designed crate having provision for collection of faeces and urine separately. Animals were fed during the pre-experimental period for 21 days, followed by experimental metabolic trial of 7 days. The experimental design was a randomized blocks with four replications. Silage supplementation increased total dry matter intake from 478.3 g/animal/d in the control to 712.8 g/animal/d in 50%HBH + 50% silage ($P \leq 0.01$). There were not significant ($P \geq 0.05$) differences between silages treatments. *Albizia lebbeck* silage supplementation had a highly significant ($P \leq 0.01$) effect on nitrogen utilization by sheep. All diets resulted in a positive N balance. Nitrogen intake and nitrogen retained as percent of intake rose with increasing levels of silage until 50%. However, there were not significant diferences ($P \leq 0.05$) among silages diets. Nitrogen intake and nitrogen retention were the highest (7.7 g/animal/d and 59.9%) in the 50% HBH + 50% silage diet and the lowest (3.1 g/animal/d and 12.99%) in the HBH diet. It can be concluded that supplementation with *Albizia lebbeck* silage had potential as protein source for sheep fed with a poor quality basal diet.

Key Words: *Albizia lebbeck*, Silage, Intake

T145 *In sacco* rumen disappearance of condensed tannins, fiber, and nitrogen from herbaceous native Texas legumes in goats. D. L. Pawelek*[1,2], J. P. Muir[1], B. D. Lambert[1,2], and R. D. Wittie[2], [1]*Texas Agricultural Experiment Station*, *Stephenville*, [2]*Tarleton State University*, *Stephenville, TX*.

Condensed tannins (CT) can play a role in rumen protein and fiber degradability, especially in legumes high in CT. In order to better understand their potential role in ruminant nutrition, three legume species native to Texas, *Acacia angustissima* var. *hirta* (prairie acacia) (288 g/kg neutral detergent fiber (NDFom), 41 g/kg N), *Desmodium paniculatum* (panicled tick-clover) (480 g/kg NDFom, 25 g/kg N), and *Lespedeza procumbens* (trailing bush-clover) (401 g/kg NDFom, 22 g/kg N) were studied to determine *in sacco* rumen disappearance rates of key nutritional components compared to that of *Medicago sativa* (alfalfa) (227 g/kg NDFom, 35 g/kg N). Herbage was incubated in rumen-cannulated goats fed a basal diet of *Sorghum bicolor* ×x *S. sudanense* (sorghum-Sudan) hay, with disappearance measured at 0, 4, 8, 16, 28, 48 and 96 h. Among the native legumes, the highest CT concentrations were measured in prairie acacia (263 g CT/kg DM foliage) and the lowest (120 g CT/kg DM) in trailing bushclover. The lowest concentrations of acid detergent fiber (ADFom), NDFom, and sulfuric acid lignin (lignin (sa)) were measured in prairie acacia, the first two fractions being comparable to alfalfa. Proportion remaining was calculated for CT, ADFom, lignin(sa), NDFom, and N for 0, 24 and 48 h of rumen incubation. Disappearance parameters were measured for ADFom, lignin(sa), NDFom and N for the three native legumes and compared to alfalfa. Alfalfa had the highest disappearance of all degradable fractions except lignin(sa). Potential disappearance (PD) fraction for ADFom, lignin(sa) and N were lower for the native legumes vs. alfalfa. No differences in N proportion remaining at 24 and 48 h occurred in the native legumes despite differences in protein-bound CT proportion remaining at those same times. Of the native legumes studied, prairie acacia shows the greatest potential for contributing rumen-escape protein, suggesting it may be a candidate for further development as a pasture and rangeland renovation legume.

Key Words: Proanthocyanidins, Escape Protein, Protein-Bound Condensed Tannins

T146 Season and drying method effects on condensed tannin levels in perennial herbaceous legumes. R. M. Wolfe*[1], T. H. Terrill[2], and J. P. Muir[1], [1]*Texas Agricultural Experiment Station*, *Stephenville*, [2]*Agricultural Experiment Station, Fort Valley State University*, *Fort Valley, GA*.

Several factors affect condensed tannin (CT) levels in plants and the precision and accuracy of the butanol-HCl colorimetric assay for CT in extractable and bound forms. Six native, perennial, herbaceous legumes from Texas were harvested at three different stages of growth over a growing season; young vegetation, initial flowering, and late in the season before leaf drop. Legumes examined were Eastern prairie acacia (*Acacia angustissima*), Illinois bundleflower (*Desmanthus illinoensis*), Panicled tick-clover (*Desmodium paniculatum*), Creeping bush-clover (*Lespedeza procumbens*), Tall bush-clover (*Lespedeza steuvei*) and Tropical neptunia (*Neptunia pubescens*). The samples were subjected to oven-drying and freeze-drying and then analyzed for extractable (ECT), protein-bound (PBCT), and fiber-bound (FBCT) condensed tannin concentration using a butanol-HCl procedure with purified quebracho CT as the standard. There was a wide range of CT concentration in the legumes, but little change in ECT and total (TCT) tannin concentrations over the growing season. Oven-drying decreased ($P < 0.05$) ECT and increased ($P < 0.05$) PBCT and FBCT concentrations in the legumes compared with freeze-drying, but both methods ranked the forages similarly throughout the growing season relative to TCT. Use of quebracho tannin as a standard increased CT values for the forages compared with purified legume CT standards, but all standards ranked the forages similarly relative to tannin concentration. Quantitative CT values are affected by many factors and have limited value except to allow a relative ranking of forages. Biological activity and potential nutritional/medicinal benefits of CT in native legumes needs further evaluation.

Key Words: Legumes, Tannins, Drying

T147 Effects of individual terpenes and terpene mixtures on intake by lambs. R. E. Estell*[1], E. L. Fredrickson[1], D. M. Anderson[1], and M. D. Remmenga[2], [1]*USDA/ARS Jornada Experimental Range*, *Las Cruces, NM*, [2]*New Mexico State University*, *Las Cruces*.

Rangeland degradation due to shrub encroachment is a major concern to livestock producers and land managers in the western United States and in arid and semiarid regions worldwide. Most invasive shrubs contain secondary compounds that reduce their consumption by herbivores, but knowledge concerning the effects of specific

compounds is limited. Four experiments were conducted to determine the effects of individual terpenes (*cis*-β-ocimene and *cis*-sabinene hydrate; Exp. 1 and 2) or mixtures of monoterpenes (borneol, camphene, camphor, 1,8-cineole, limonene, myrcene, and α-pinene; Exp. 3) or sesquiterpenes (β-caryophyllene, caryophyllene oxide, α-copaene, and α-humulene; Exp. 4) on intake by lambs. After a 10-day adaptation period with untreated alfalfa pellets, lambs (n = 45) were individually fed treated alfalfa pellets for 20 min each morning for 5 days. Five treatments (0X, .5X, 1X, 2X, and 10X; multiples of the concentrations of the same terpenes in *Flourensia cernua*) were applied to alfalfa pellets (637 g, DM basis) in an ethanol carrier. Except during the 20-min test, lambs were maintained outdoors and fed untreated alfalfa pellets (total mean intake = 4.7% of BW, DM basis). Day × treatment interactions were detected ($P < 0.04$) in Exp. 1 and 4 because of greater intake for 0X than other treatments on day 1 (Exp. 1) and lower intake for the 10X treatment on day 1 and 2 in Exp. 4. A trend for decreased intake (g/kg BW) as concentration of the sesquiterpene mixture increased was observed ($P = 0.093$ for the linear contrast; Exp. 3). Although there was a tendency for the sesquiterpene mixture to decrease intake, *cis*-β-ocimene, *cis*-sabinene hydrate, and the monoterpene mixture did not appear to affect intake by lambs.

Key Words: Intake, Shrubs, Terpenes

T148 Evaluation of hay treated with acid based preservatives at two cuttings and three moisture levels on their effect on feeding value. D. Sapienza[1], F. R. Valdez*[2], D. Westerhaus[2], and W. Rounds[2], [1]*Sapienza Analytica LLC*, *Slater, IA*, [2]*Kemin Industries, Inc.*, *Des Moines, IA*.

The production of hay with high feeding value is dependent upon drying conditions. This evaluation was designed to quantify the upper limit in moisture content in hay and to evaluate the effectiveness of hay additives. Four hay additives were used, three in accordance with label and one, FRESH CUT® Plus brand hay preservative (FC+), outside label directions to evaluate the range of its effectiveness. Six bales were made of each treatment in two cuttings (May and October 2005). After twenty-one days, temperature measurements were taken at four locations in each bale. The data were then converted into heat units and the effects of the treatments were evaluated. There was a significant reduction ($P<0.05$) of heat units produced in the bales made at less than 20% moisture; those bales treated with FC+ showed a significant 13-unit reduction ($P<0.05$) in heat units when compared to bales made with no additive. FC+ also showed a significant reduction in heat units produced ($P<0.05$) when compared to treatment with two other commercial products. All bales exhibited some heating and the internal temperature of all bales trended with the highs and lows of the environment. Over all moisture levels tested (26%, 20 to 25% and <20%), the FC+ treated bales demonstrated the ability to maintain a visual color score corresponding to normal good green bale color (score 3.2 to 2.2). It appears from the data that FC+ was able to reduce the negative effects of the normal temperature cycle of wet and dry bales observed throughout this experiment. It was also apparent that the TDN values for all of the 15 and 22% moisture bales treated with FC+ were greater than the positive control. FC+ improved TDN mainly by increasing crude protein digestibility (r = -0.918) and lowering % acid insoluble digestible crude protein (r = -0.926). No treatment was effective at 27% moisture.

Key Words: Hay Preservatives, Heat Units, Crude Protein Digestibility

T149 Loss of dry matter of pure and inoculated sugarcane (*Saccharum spp*) silage. G. S. Dias Júnior, D. C. L. Miranda, M. N. Pereira*, G. Santos, F. Lopes, and R. Spuri, *Universidade Federal de Lavras*, *Brazil*.

Sugarcane is a viable forage for feeding bovine, since it has a high potential for producing dry matter, of high energy content, per hectare. The ensiling of sugarcane may be an alternative to the traditional feeding management of daily harvesting fresh forage. The ensiling of the forage may facilitate the management of the herd, allows use of the forage during the rainy season, and maximizes the efficiency of cultural practices, among other advantages. However, consequences of the alcoholic fermentation of the sugarcane are the high sucrose loss and the low aerobic stability of the unloaded silage. We evaluated the loss in nutrient mass, along 767 days of ensilaging, of nine 1.9 kg pure sugarcane samples. The NDF content increased from 47.0% of DM to 68.7%. Silage loss, proportional to the original, was: 32.8% for toluene DM, 44.1% for 100°C DM, 18.3% for NDF and 67.0% for the non-NDF DM. We also evaluated the loss of nutrient mass and heating following unloading of sixty 7.9 kg sugarcane samples ensiled for 40 days. The three treatments were: Control, *L. plantarum* (1 × 106 cfu/g of FW) or *L. buchneri* (6.6 × 105 cfu/g of FW). The ensiling increased the sugarcane NDF content from 47.5% of DM to 70.5%. On average, the losses in nutrient mass were: 23.9% for toluene DM, 34.0% for 100°C DM, 1.9% for NDF and 62.9% for the non-NDF DM. While *L. plantarum* reduced, *L. buchneri* increased the loss of 100°C DM loss ($P<0.05$), in spite of the small biological magnitude of the effect (±1.6 percentage units). There was no treatment effect on silage heating following unloading. The ensiling of the sugarcane induced a significant increase in NDF content of the fresh forage and a high nutrient loss.

Funded by Chr Hansen and CNPq

Key Words: Inoculum, *L. plantarum*, *L. buchneri*

T150 Determinants of degradability among sugarcane (*Saccharum spp*) clones in the bovine rumen. C. B. Teixeira, M. N. Pereira*, M. A. P. Ramalho, M. H. Ramos, J. F. Santos, and M. L. Chaves, *Universidade Federal de Lavras*, *Brazil*.

The objective of this study was to evaluate the variability of nutritive value among sugarcane clones, to estimate the correlation between plant digestibility and productivity, and to define which agronomical and chemical traits would be the most important determinants of nutritive value. Twenty sugarcane industrial clones were evaluated in a completely randomized block design with four replicates. Clones cultivated in Campos, RJ state, originated from the Plant Breeding Program for Sugar and Alcohol Production of the Federal Rural University of Rio de Janeiro. Plants were harvested when the Brix was superior to 18%, at an starting age of 370 days after the second ratoon cut. Nine agronomical traits, ten chemical traits and the ruminal NDF and DM *in situ* degradability were evaluated. Productivity was 21.2 ± 5.7 t of DM per hectare, ruminal DM degradability was 57.1 ± 2.6% of DM, and ruminal NDF degradability was 19.8 ± 2.42% of NDF (mean ± SD). None of the variables evaluated had a significant correlation to NDF degradability ($P>0.10$). The ADF as a % of DM (%ADF), stalk length (SL) and the percentage of stalk in whole plant DM (SP) were the only variables included in the multivariate regression model

correlating ruminal DM degradability to chemical and agronomical traits. Models were: 95.13 - 1.238 (%ADF) (r^2=0.70); 100.80 - 0.452 (SL) - 1.140 (%ADF) (R^2=0.75); 83.48 - 0.052 (SL) + 0.179 (SP) - 1.009 (%ADF) (R^2=0.81). There was no evidence for decreased productivity as a consequence of a possible selection of clones to achieve high digestibility, since the phenotypic as well as the genetic correlation between these traits were close to zero. The estimated h^2 for the ruminal DM degradability trait was 87,9%, for %ADF it was 19.5%, for SL it was 41.4% and for SP it was 63.1%. Improving digestibility by indirect selection did not seem justifiable, since traits indirectly correlated to the digestibility had smaller estimated h^2 values than the value obtained for the ruminal DM degradability trait.

Key Words: Digestibility, Heritability, Plant Breeding

T151 Change in dry matter content of sugarcane silage treated with chemical and microbiological additives. D. C. L. Miranda, G. S. Dias Júnior, M. N. Pereira*, R. Spuri, F. Lopes, and G. Santos, *Universidade Federal de Lavras*, *Brazil*.

The ensilaging of sugarcane may be an alternative to the traditional feeding management of daily harvesting fresh forage. However, consequences of the alcoholic fermentation of sugarcane are the high sucrose loss and the low aerobic stability of the unloaded silage. We evaluated the use of chemical and microbiological additives in sugarcane silage. Around 9 kg forage samples were ensiled in 20 l buckets. A 4x3 factorial arrangement of treatments was adopted. Chemical additives: Control, potassium sorbate (0.05% of fresh weight, FW), urea (1% of FW) and calcium hydroxide (1% of FW). Microbiological additives: Control, *L. plantarum* and *L. buchneri* (both at 1 × 106 cfu/g of FW). Each one of the twelve possible combinations of treatments was replicated six times in each day of silage opening: 7, 14, 28 and 77 days of ensilaging. There was no treatment effect on the 126-hour heating of the unloaded silage (P>0.13). The inclusion of calcium hydroxide reduced the NDF content from 79.9% of DM to 69.2% (P<0.01). Both urea and calcium hydroxide increased silage pH, being the increase more accentuated on day 77 (P<0.01 for the interaction between chemical additive and day of opening), and was associated to the occurrence of 39% of silages with clostridial fermentation in the urea treatment and 56% with calcium hydroxide, both only during day 77 of silo opening (P<0.01, Chi-Square). The association of sorbate with microbiological additives increased the DM content at 7 and 77 days of ensilaging, while the association between urea and inoculum had a positive action only on day 77 (P=0.04 for the interaction among chemical additive, microbiological additive and day of opening). The association between potassium sorbate and microbial inoculum improved the action of homo as well as heterofermentative microorganisms. However, the effect of microbial inoculants on DM content was small. The use of calcium hydroxide in sugarcane ensiled for less than 28-day periods, may be a way to reduce the fiber content of the feed.

Funded by Chr Hansen and CNPq

Key Words: Calcium Hydroxide, Potasium Sorbate, Inoculum

T152 The effect of feeding sugar cane (*saccharum officinarum*) or corn silage to Holstein heifers on development and reproductive performance. J. A. Reyes-Gutierrez[1,2], J. M Palma-García[2], J. M. Tapia-Gonzalez*[1], I. E. Morales-Zambrano[1,2], and G. Rocha-Chavez[1], [1]*CUSUR Univ de Guadalajara*, *Cd Guzman Jalisco Mexico*, [2]*Univ de Colima*, *Mexico*.

The objective of this study was to asses developing and reproductive performance of Holstein-Freisan heifers from weaning up to 470 days of age comparing sugar cane (*saccharum officinarum*) silage (SCS treatment 1) and corn silage (CS treatment 2). Twenty eight weaned heifers averaging 80 ± 16 days of age and initial weight of 79.5 ± 12.9 kg were used in a randomized block arrangement with weight as the blocking factor. Heifers were offered the respective silage *ad libitum* and a supplement was used to reach requirements. Body weight, BW (Kg) was measured every 30 days as well as height at cross HC (cm), body condition score BCS (1-5 scale), daily gain DG (kg), feed efficiency FE (Kg), forage intake FI (Kg), supplement intake SI (kg), and feed costs per pound of gain FCPG (US Dollars). Furthermore, age in days was registered at the time of puberty and first mating as well as BW, BCS and HC. Analysis of variance was used to compare treatments and significance was set to P<0.05. Growth performance of heifers at the end of the trial is described in table 1. Heifers reached puberty at 346.8 and 335.2 days old, weighing 250.6 and 279.1 kg for treatment 1 and 2 respectively (significantly different at P<.05). The body condition score and height at cross for SCS and CS groups were 2.6 and 3.2 and 116.8 and 118.9 cm respectively. At first mating, heifers were 441.1 and 430.1 days old, weighing 331.9 and 332.6 kgs, with a BCS of 2.8 and 3.5 and HC of 123.8 cm and 125.6 cm respectively for treatment 1 and 2. Reproductive performance at first mating was as the following: 1.1 and 1.3 matings per pregnancy and 92.8% and 78.5% fertility rate for SCS and CS respectively. It was concluded that, under conditions of this study, the SCS-based system allows for a satisfactory daily gain and reproductive performance at a low cost compared with corn silage.

Table 1. Development performance of heifers feed on corn or sugar cane silage

	BCS	Daily Gain (Kg)	Feed effiency (Kg)	Forage intake (Kg)	Supplement intake (Kg)	Feed costs per pound of gain (USD)
Sugar cane silage	2.7 a	.666	7.1 a	3.1	1.6	0.58
Corn silage	3.11 b	.743	9.2 b	5.3	1.6	0.63

Different letter in the same column differ significantly (P<0.05)

Key Words: Heifers, Sugar Cane, Silage

T153 Evaluation of the nutritive value of traditional forages collected during the growing season for improving livestock production in Mali. B. Dembele*[1], S. Fernandez-Rivera[2], B. Simpson[3], and M. Yokoyama[3], [1]*Institut Polytechnique Rural de Formation et de Recherche Appliquee*, *Katibougou, Mali*, [2]*International Livestock Research Institute*, *Addis Ababa, Ethiopia*, [3]*Michigan State University*, *East Lansing*.

Mali is a landlocked, semi-arid country in West Africa and one of the ten poorest countries in the world. Poor animal nutrition is the

limiting constraint to increased livestock productivity and the major contributory aspects of the problem are feed availability and quality. Livestock are fed natural grasses, fodder and farm residues during the dry season, which are poor in quality. The inability of the market place to meet the demand for feed places increasing pressure on existing natural resources. Changes in the nutritive value of forages over the growing season are unknown. In this study, traditional forages were randomly collected monthly from the beginning of the rainy season to the dry season (July, 2004-February, 2005) and analyzed for their nutritive value(DM, CP, Ether Extract, Ash, NDF, ADF, ADL, Gross Energy, In Vitro Dry Matter Digestibility) and mineral content (Ca, P, K, Fe, Mg, Cu, Zn, Na, Mn). The dominant forages during the growing season were Angropogon pseudapricum, Loudecia togoenesis and Pennisetum pedicellatum. Many forages disappeared late in the growing season. Mean CP of the forages decreased from 12.6% to 1.9% (range:12.6-1.3%) during the growing season. Mean ADF increased from 33% to 48% (range:33-50%). Mean ADL increased from 4.6 to 5.3% (range 4.6-6.1%). Mean NDF increased from 50% to 73% (range: 50-76%). Mean OM% increased from 89.9% to 95.5% (range 89.9-95.5%). Mean Ash decreased from 10.1 to 4.5% (range 10.1-4.5%). Mean Ether Extract % decreased from 1.28% to 0.76% (range: 1.28-0.68%). Mean In Vitro Dry Matter Digestibility decreased from 73% to 65% (range:73-60%). Mean Ca, P, K, Mg, Na, Cu, and Zn content all decreased, while Mn increased. The data indicates that traditional forages decline in nutritive value during the growing season in Mali. (Supported by USDA, ISE Competitive Grant No. 2005-51160-02276).

Key Words: Mali, Forages, Nutritive Value

Goat Species II

T154 *In vitro* volatile fatty acid profile of shrub and cacti species selected by grazing goats. M. Guerrero-Cervantes[1,2], R. G. Ramírez-Lozano[2], R. Montoya-Escalante[1], A. S. Juárez-Reyes[1], and M. A. Cerrillo-Soto*[1], [1]*Universidad Juárez del Estado de Durango, Durango, Dgo., Mexico*, [2]*Universidad Autónoma de Nuevo León, Monterrey, N.L., Mexico*.

Samples from species commonly selected by range goats in the semiarid region of North Mexico were collected to study their *in vitro* volatile fatty acid production. Samples from *Quercus grisea*, *Acacia shaffneri*, *Proposis leavigata*, *Opuntia leucotricha*, *O. leptocaulis* and *O. imbricata*, were collected . Five hundred mg DM were incubated in triplicate in calibrated 100 ml glass syringes using rumen fluid from two sheep fed alfalfa hay: concentrate (75:25) as inoculum. Incubations were terminated after 24 h. The syringe contents were then centrifuged and 5 ml of the supernatant were mixed with 1 ml of 25% metaphosphoric acid. Volatile fatty acid determination was performed using gas chromatography. Data were analyzed by ANOVA according to a completely randomized design. Total VFA concentrations were highest for *Opuntia leucotricha* whereas lowest values were recorded in *Acacia shaffneri* ($P < 0.05$). A similar trend was observed for acetate concentrations among species. *Opuntia leucotricha* produced 24.2% more acetate than *Acacia shaffneri*. Intermediate values were obtained in *O. leptocaulis* and *O. imbricata* ($P < 0.05$). Propionate concentrations were different among species ($P < 0.05$). *O. imbricata* recorded the highest values, *Proposis leavigata* was intermediate and *Acacia shaffneri* the lowest. Regarding butyrate values, a similar pattern as propionate was observed. *O. imbricata* produced 42.5% more butyrate than *Acacia shaffneri* ($P < 0.05$). *Opuntia leucotricha* resulted in higher valerate values, *O. imbricata* and *Q. grisea* ranked intermediate and *A. shaffneri* the lowest ($P < 0.05$). A higher A:P ratio was observed in *O. leucotricha* and lowest in *P. leavigata*. Results indicated that cacti species, specially *O. leucotricha* represents a good energy source and an important emergency feed in harsh semi-arid areas.

Table 1. *In vitro* VFA profile (mM L^{-1}) of shrub, tree and cacti species

	Total	C:2	C:3	C:4	C5	A:P
Q. grisea	14.17^{c}	8.91^{cd}	1.44^{cd}	1.17^{c}	0.96^{b}	6.10^{c}
A. shaffneri	10.88^{c}	6.05^{d}	1.10^{d}	0.94^{c}	0.86^{d}	5.53^{c}
P. leavigata	16.14^{bc}	9.49^{cd}	3.13^{b}	1.03^{c}	0.92^{c}	3.00^{d}
O. leucotricha	30.25^{a}	24.95^{a}	1.99^{cd}	1.82^{b}	1.03^{a}	12.6^{a}
O. leptocaulis	23.00^{ab}	17.90^{b}	2.12^{c}	1.72^{b}	0.87^{d}	8.45^{b}
O. imbricata	23.44^{ab}	14.36^{bc}	4.35^{a}	2.23^{a}	0.99^{b}	3.22^{d}
Mean	19.65	13.61	2.35	1.48	0.94	6.50
SEM	3.46	2.76	0.43	0.15	0.01	0.74

Means within columns with different superscript differ ($P<0.05$)

Key Words: Goats, *In vitro*, Volatile Fatty Acids

T155 Methane emission by goats consuming a condensed tannin-containing lespedeza, alfalfa and sorghum-sudangrass. G. Animut*[1], R. Puchala[1], A. L. Goetsch[1], A. K. Patra[1], T. Sahlu[1], V. H. Varel[2], and J. Wells[2], [1]*E (Kika) de la Garza American Institute for Goat Research, Langston, OK*, [2]*US Meat Animal Research Center, Clay Center, NE*.

Twenty four Boer × Spanish (1/2 Boer; initial BW of 38.3 ± 0.69) wethers six per treatment were used to assess effects of a condensed tannin (CT)-containing forage (sericea lespedeza, *Lespedeza cuneata*; S) with or without polyethylene glycol (PEG), a legume (alfalfa, *Medicago sativa*; A), and grass (sorghum-sudangrass, *Sorghum bicolor*; G) on ruminal methane emission. Treatments were S, S plus 25 g/d of PEG mixed with 50 g/d of ground corn (P), A, and G. Forages harvested daily were fed at 1.3 times the maintenance energy requirement. The experiment lasted 15 d, 7 d for adaptation and 8 d for measurement.

Digestibility of DM differed (P < 0.05), whereas digestible DMI and energy expenditure (EE) were similar among treatments (DM digestibility: 49.5, 52.1, 60.9, and 66.5% (SE = 2.22); digestible DMI: 415, 448, 442, and 475 g/d (SE = 26.3); EE: 462, 456, 509, and 476 kJ/kg $BW^{0.75}$ (SE = 17.0) for S, P, A, and G, respectively). Methane emission was 15.8, 20.9, 21.3, and 21.6 l/d for S, P, A, and G, respectively (SE =1.25), and was lower for S compared with other treatments (P < 0.05). There was also a difference (P < 0.05) among treatments in in vitro methane release by ruminal fluid incubated for 3 wk with conditions promoting activity by methanogens (12.9, 21.8, 25.3, and 28.5 ml for S, P, A, and G, respectively; SE = 2.73). In summary, CT-containing forage S decreased methane emission by goats, possibly by altering activity of ruminal methanogenic bacteria, and it did not appear that dietary differences of forages other than CT level might play a significant role in reducing ruminal methane emission.

Key Words: Goats, Methane, Condensed Tannins

T156 Evaluation of level of crude protein and undegradable intake protein level in diets of growing Boer goats fed a complete pelleted ration. G. V. Pollard*[1], K. F. Wilson[2], and M. L. Bolfing[1], [1]*Texas State University*, *San Marcos*, [2]*Animal Feed Technologies*, *Greeley, CO*.

The objectives of this research were to determine the effects of dietary crude protein and undegradable intake protein (UIP) levels on growth and carcass characteristics of crossbred Boer meat goats. Forty-eight crossbred wether goats (23.1 kg) were assigned to 16 pens in a completely randomized design. Crude protein level and UIP level were randomly assigned to goats in a 2 × 2 factorial arrangement. Factors were: A) 15 or 18% CP, and B) 40% or 60% UIP level. All goats received a complete, pelleted diet fed at approximately 3.5% of BW consisting of corn, oats, alfalfa, cottonseed hulls, soybean meal, blood meal, fish meal, dried distillers grains, urea, and monensin with appropriate levels of minerals and vitamins, and free access to water for 84 d prior to slaughter. Levels of cottonseed hulls, blood meal, and soybean meal were altered to produce the diets listed previously. Performance variables measured were ADG, FC (gain/feed), and FI. Carcass variables measured were hot carcass weight (HCW), dressing percentage (DP), body thickness (BT), back fat (BF), leg score, and muscle conformation (MC). Data were analyzed as a factorial with resulting means separated by main effects since no interactions were observed using SAS. As expected, no differences (P = 0.830) were detected for FC and FI due to all goats fed at 3.5% of BW. Average daily gains were lower (P = 0.03) during the initial 28 d period for all treatments than during the final 56 d of the study. Diets containing 60% UIP tended (P = 0.17) to have greater ADG over the entire 84 d, while the diet containing 18% CP and 40% UIP had lower (P = 0.07) ADG. However, no differences (P = 0.38) for growth were detected when comparing 15 and 18% CP diets. Goats receiving diets containing 15% CP tended (P = 0.13) to have heavier HCW. The results of this study suggest that meat goats with Boer influence may not require diets with increased levels of crude protein or undegradable intake protein when fed at 3.5% of BW.

Key Words: Boer, Goat, Protein

T157 Effects of dietary methionine and lysine sources on particular blood parameters in growing goats. Z. H. Sun[1], Z. L. Tan*[1], G. O. Tayo[1,2], B. Lin[1], and S. X. Tang[1], [1]*Institute of Subtropical Agriculture, The Chinese Academy of Sciences*, *Changsha, P.R. China*, [2]*Babcock University*, *Ikeja Lagos, Nigeria*.

The objective of this study was to study the effects of supplementing various sources of methionine (Met) and lysine (Lys) on certain plasma variables. Four wether goats (20.0±0.5 kg) were used in a 4×4 Latin square experiment and assigned to four dietary treatments: (1) control; (2) control+lipid-coated Met-Zn chelate and Lys-Mn chelate (PML); (3) control+Met-Zn chelate and Lys-Mn chelate (CML); (4) control+DL-Met, L-Lys-HCl (FML). The amounts of Met and Lys supplemented in the four treatments were 0.77 g and 0.91 g per 100 g concentrate (DM basis). Control and FML groups were supplemented with 0.09 g/100 g (DM basis) ZnSO4.7H2O and 0.05 g/100 g MnSO4.H2O in the concentrate to keep the same content of Mn and Zn among the four diets. The basal diet consisted of 50% maize stover and 50% concentrate. Ten ml blood sample was collected from the jugular vein of each goat for analyses of plasma biochemical indices at the end of each period. Goats offered PML had higher plasma growth hormone concentrations than control (P<0.05), and higher plasma insulin concentration than in the FML group (P<0.05) and control (P<0.01). Plasma insulin concentration in CML group was higher than in control (P<0.05). T3 serum concentrations of PML and CML groups were higher than in the FML group and control (P<0.05). The activity of alkaline phosphatase in plasma of PML and CML groups was higher than those of FML group and control (P<0.05), and there was no difference in alkaline phosphatase between PML and CML groups (P>0.05). Plasma levels of triglycerides and total protein and lipase activity did not differ among treatments (P>0.05). The results indicate that chelated Met and Lys supplementation can affect some plasma parameters in growing goats, and the lipid-coated technology could be of potential benefit for AA utilization.

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Key Words: Growth Hormone, Triglycerides, Alkaline Phosphatise

T158 Effects of dietary NDF level on the duodenal and ileal flows of endogenous nitrogen and amino acids in growing goats. C. S. Zhou, Z. L. Tan*, H. L. Jiang, Z. H. Sun, and S. X. Tang, *Institute of Subtropical Agriculture, The Chinese Academy of Sciences*, *Changsha, P.R. China*.

The objective of this study was to investigate effect of dietary NDF levels on the duodenal and ileal flows of endogenous nitrogen (EN) and endogenous amino acids (EAAs) in growing goats. The duodenal EN and EAAs flows were determined by the difference method and the amino acid profile (AAP) as described by Larsen (2000) and Jensen (2006) respectively. The ileal EN and EAAs were measured by the water soluble N (WSN) and linear regression method described by Larsen (2000) and Van Soest (1982) respectively. A trial with four ruminally, duodenally and ileally cannulated goats (BW=25.0±2.5 kg) were allocated to four treatments in a 4×4 Latin square design. Goats were fed diets containing four levels of NDF (39.69%, 36.95%, 34.22% and 31.49%), respectively. The duodenal flow of EN and EAAs was 1.05, 1.12, 1.01, 1.06 g/d (P>0.05) and 12.62, 11.37, 12.19,

11.18 g/d (P>0.05) as determined by the difference method; and 1.31, 1.37, 1.30, 1.36 g/d (P>0.05) and 7.73, 6.79, 6.29, 6.14 g/d (P>0.05) as determined by AAP method respectively for the four dietary treatments. The duodenal EN determined by AAP was 22-29% higher than that determined by the difference method, while the duodenal EAAs determined by the difference method was two times that by AAP. The ileal flow of EN and EAAs was 0.59, 0.58, 0.55, 0.54 g/d (P>0.05) and 5.28, 5.22, 5.16, 5.28 g/d (P>0.05) determined by WSN. The regression equations of the duodenal and ileal flow of EN (Y, g/d) and the flow of N (X, g/d) were Y=0.12X (R^2=0.94, P<0.01) and Y=0.23X (R^2=0.94, P<0.05), respectively. Results indicated that dietary NDF level within the range of 39% to 31% did not affect the duodenal and ileal flows of EN and EAAs and that the determination technique had significant effect on the duodenal and ileal flows of EN and EAAs.

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Key Words: Endogenous Nitrogen, Endogenous Amino Acids, Determining Technique

T159 Effects of dietary NDF levels on digestion, serum biochemical parameters and hormonal concentrations in growing goats. X. G. Zhao[1], H. L. Jiang[1], Z. H. Cong[1], S. X. Tang[1], Z. H. Sun[1], Z. L. Tan*[1], and G. O. Tayo[1,2], [1]*Institute of Subtropical Agriculture, The Chinese Academy of Sciences*, *Changsha, China*, [2]*Babcock University*, *Ikeja Lagos, Nigeria*.

The effects of dietary NDF levels on digestion and serum biochemical parameters were examined in this study. Four growing wether goats (19.6 ± 1.2 kg) were used in a 4×4 Latin square experiment, assigned to one of four dietary treatments. The four diets contained 16.4, 19.9, 23.2 and 26.6% forage with 31.5 (LF), 34.2 (MF1), 37.0 (MF2) and 39.7% (HF) NDF on dry matter basis, respectively. Other chemical components were the same for the four diets. Each experimental period lasted 19 d, which included 14 d of adaptation followed by 7 d sampling period. The amount of feed offered to each goat was restricted to 85% of its ad libitum intake to maintain no orts during the whole experimental period. Blood samples (15 ml) was collected from the jugular vein of each animal at day 19 of each experimental period. The total tract digestibility of DM (P = 0.05), OM (P = 0.01), N (P = 0.01) and NDF (P = 0.05) decreased linearly with increase in dietary NDF level. Goats offered the LF diet had higher levels of serum total protein (P < 0.05) and higher urea nitrogen (P < 0.05) than goats offered MF2 and HF diets. LF diet also resulted in higher amylase activity and serum glucagon concentration than MF1 and MF2 diets, respectively (P < 0.05). Serum trijodthyronin concentration decreased with the increase of dietary NDF level (P < 0.05). Serum lactic acid, glucose, lipase, growth hormone, insulin, leptin, motilin and thyroxin concentrations, and activity of lactate dehydrogenase did not differ between treatments (P > 0.05). The results indicated that increasing dietary NDF content decreased the total tract digestibility of DM, OM, CP and NDF within the current range of 31~40% NDF in dietary DM and partly affected biochemical parameters in growing goats.

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Key Words: Blood Variables, Digestion, Neutral Detergent Fiber

T160 Selenium concentrations in forages and in blood of meat goats. T. K. Hutchens*[1], A. H. Cantor[1], H. D. Gillespie[1], P. B. Scharko[1], M. Neary[2], and J. E. Tower[2], [1]*University of Kentucky*, *Lexington*, [2]*Purdue University*, *West Lafayette, IN*.

Forages grown in many areas of the USA are considered to be selenium-deficient. These regions include Indiana and Kentucky. The present study was conducted to determine Se concentrations in pasture and hay samples and in blood and plasma samples of goats consuming these forages. A composite sample of Kentucky 31 tall fescue was obtained in August 2006 from 10 locations within a 10-acre grazing paddock in Dubois, IN. In addition, four grab samples of alfalfa-orchardgrass hay from an early summer cutting were taken. Blood samples were obtained from percentage Boer-crossed meat does, approximately 3 yr of age, in August and December of 2006 and in January 2007. Selenium was determined using a fluorometric procedure following wet digestion. The pasture and hay samples contained 0.055 ± 0.009 µg Se/kg DM and 0.044 ± 0.010 µg Se/kg DM (mean ± SD), respectively. Goats sampled shortly after weaning in August 2006 (n = 10) were on pasture with access to a mineral supplement containing Se. Their respective values (µg/mL) for whole blood and plasma Se were 0.132 ± 0.022 and 0.066 ± 0.011. Does sampled in December 2006 (n = 8) had been bred, were still on pasture and were given hay with access to the mineral supplement. Their whole blood and plasma Se concentrations were 0.191 ± 0.028 and 0.071 ± 0.007 µg Se/mL, respectively. The same does sampled in January 2007 (n = 8) had continued to receive the same feeding regimen. Whole blood and plasma Se concentrations from these goats were 0.198 ± 0.031 and 0.078 ± 0.006 µg Se/mL, respectively. Average Se concentrations for whole blood, but not for plasma, of samples taken in December and January were significantly (P < 0.001) higher than for samples taken in August. These data show that the forages sampled were very low in Se content. In addition, a substantial change in the Se concentration in whole blood, but not in plasma, of breeding does was observed during the course of sampling.

Key Words: Forages, Goats, Selenium

T161 Supplementation with selenium boluses and its effect on milk and blood serum concentration of dairy goats. J. G. Librado Cruz*[1], M. Huerta Bravo[1], M. González Alcorta[1], J. G. García Muñíz[1], P. A. Martínez Hernández[1], and R. López Arellano[2], [1]*Universidad Autónoma Chapingo*, *Chapingo, México*, [2]*Facultad de Estudios Superiores Cuautitlán, UNAM*, *Cuautitlán Izcalli, México*.

The objective of this trial was to determine the effect of supplementing oral selenium (Se) boluses on blood serum and milk selenium concentrations of lactating dairy goats. Forty lactating dairy goats grazing natural rangelands from two flocks (twenty animals for each one) were assigned randomly to two treatments: 0 and 500 mg of Se per bolus. Blood and milk samples were collected at 0, 8, 15, 22, 36, and 50 d post treatment to determine Se concentrations. Data were analyzed using a mixed model with repeated measures. Goat was the random effect while flock and treatment were the fixed effects. Initial live weight, milk yield, and number of kidding were included as covariates, when appropriate. Selenium concentrations were determined by acid decomposition-fluorometric detection. Milk Se concentrations were affected (P = 0.0012) by flock × treatment interaction. In one flock, the supplemented goats had 15.3% more milk Se in comparison with non-supplemented animals. However, there was no response in

milk Se concentration in the other flock. Concentrations of Se in blood serum were influenced (P = 0.0002) by treatment × flock × sampling day interaction. In both flocks, supplemented goats maintained higher Se levels (P < 0.0001) during the experiment than non-supplemented goats (156 ng/mL vs 93.6 ng/mL and 158 ng/mL vs 43.5 ng/mL). Concentrations of Se in blood serum for supplemented goats in both flocks showed a peak at day 8 post dosing that differed (P < 0.0001) from other sampling days. However, this peak was higher (P < 0.0001) in one flock (349 ng/mL vs 201.5 ng/mL). The administration of selenium boluses in dairy goats increases the content of Se in milk, and maintains appropriate levels of this mineral in blood serum during 50 days.

Key Words: Dairy Goats, Milk, Selenium

T162 Effects of fibrolytic enzymes and seaweed extract on performance and carcass characteristics of meat goats fed a non-pelleted diet. G. V. Pollard*[1], K. F. Wilson[2], H. Anderson[3], and R. V. Machen[4], [1]*Texas State University*, *San Marcos*, [2]*Animal Feed Technologies*, *Greeley, CO*, [3]*Anderson Consulting and Training*, *Garden City, KS*, [4]*Texas Agricultural Experiment Station*, *Uvalde*.

Meat goats (n=32), averaging 43.8 kg with a minimum of 75% Boer influence, were utilized to determine the effects of supplemental fibrolytic enzymes and (or) seaweed extract on performance and carcass characteristics when fed a non-pelleted diet. Treatments evaluated were: control, filbrolytic enzymes, seaweed extract, and fibrolytic enzymes plus seaweed extract. The diet utilized in this study was 50% concentrate and 50% roughage with fibrolytic enzymes and seaweed extract added at 200 g and 4.54 kg, respectively, per 907 kg of diet. All diets were fed at 3.5% of body weight along with unlimited access to water for 87 d. Sixteen pens with 2 goats per pen were utilized for this study. All goats were placed on the control diet for 14 d prior to initiation of the study to allow for dietary acclimation. Goats were weighed on 14 d intervals for 84 d, on d 87 all goats were shipped to a commercial slaughter plant where kosher slaughter was performed and carcass data was collected. Carcass variables measured were hot carcass weight (HCW), dressing percentage, body thickness between the eleventh and twelfth rib (BT), back fat, leg score, and muscle conformation. All data were analyzed as a randomized design using the GLM procedure of SAS. Seaweed extract did not improve ADG (P = 0.660) compared to the control (112 g/d versus 98 g/d), while the combination treatment improved (P = 0.048) ADG (162 g/d) and the fibrolytic enzyme treatment tended (P = 0.106) to improve ADG (122 g/d) compared to the control. Carcass characteristics were unaffected by treatment with the exception of BT (P = 0.130) and HCW (P = 0.212) which both tended to be improved by use of the combination treatment compared to the control. The results of this study indicate that fibrolytic enzymes and seaweed extract used in combination can improve performance of meat goats fed high roughage diets.

Key Words: Enzyme, Goat, Seaweed

T163 Effect of fibrolytic enzyme supplementation on fermentation characteristics of ensiled maize stover morphological fractions. Z. H. Sun, Z. L. Tan, and S. X. Tang*, *Institute of Subtropical Agriculture, The Chinese Academy of Sciences*, *Changsha, P.R. China*.

Effect of supplemented fibrolytic enzymes from Trichoderma longibrachiatum on in vitro fermentation characteristic of ensiled morphological fractions of maize stover was determined using gas production technique. Enzymes (Cellulase activity: 2500 IU/ml) mixed with about 1000 g leaf blade (LB), leaf sheath (LS), stem (S) and whole plant (WP) of maize stover at 0, 10, and 20 ml/kg of fresh sample before ensiling, respectively. After 60 d of ensiling, the silage was sampled for determining the gas production. Three goats (18±1 kg), fed a diet consisting of 500 g kg^{-1} concentrate and 500 g kg^{-1} forage containing DE (3.15 Mcal/kg DM) and CP (140 g/kg DM), were used as ruminal fluid donors for the preparation of inoculums. The gas production was measured in each vial after 2, 4, 8, 12, 15, 24, 48, 56 and 72 h of incubation. Gas production data were in triplicate fitted to an equation of GP=P×exp{-exp[1+r×e×(LAG-t)÷P]}; where GP is the gas production at time (t), P is the potential gas production, r is the constant rate of gas production, LAG is the lag time of fermentation. The values of P and r of ensiled S and WP were higher than those of ensiled LB and LS (P<0.05), LAG values of ensiled LB and LS were higher than those of ensiled S and WP (P<0.05). There were differences in P, r and LAG (P<0.05) for S and WP, and in P (P<0.05) for LS and LB among three enzymes treatments. These data suggest that addition of fibrolitic enzymes affected fermentation characteristic for ensiling morphological fractions of maize stover.

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Table 1.

Item	Enzyme level, ml/kg	LB	LS	S	WP
P	0	128.0^{cB}	143.7^{bC}	158.1^{aC}	166.8^{aC}
	10	138.6^{dB}	162.3^{cB}	174.9^{bB}	193.1^{aB}
	20	156.2^{cA}	183.2^{bA}	208.9^{aA}	217.9^{aA}
r	0	2.1^{cA}	2.4^{bA}	2.7^{aB}	3.1^{aB}
	10	2.2^{cA}	2.6^{bA}	3.3^{aB}	3.5^{aAB}
	20	2.5^{cA}	2.7^{bcA}	3.8^{aA}	3.7^{aA}
LAG	0	4.9^{aA}	3.1^{bA}	1.2^{cA}	1.3^{cA}
	10	4.3^{aA}	2.3^{bA}	0.3^{dA}	1.2^{cA}
	20	3.7^{aA}	3.3^{aA}	-0.8^{bB}	-0.3^{bB}

^{a,b,c,d}Means in a row or A,B,C means in a column sharing different letters are significantly different respectively.

Key Words: Maize Stover, Fermentation Characteristic, Fibrolytic Enzyme

T164 Kidding performance of Myotonic and Spanish goats mated to Boer and Kiko sires in an accelerated mating system. S. Wildeus* and J. R. Collins, *Virginia State University*, *Petersburg*.

This experiment evaluated the performance of Myotonic and Spanish does mated to Boer and Kiko sires in an 8-mo breeding scheme. A herd of 50 Spanish and 40 Myotonic does were mated in single sire groups to 4 Boer and 4 Kiko bucks during 30-d breeding periods in November, July and March. Each breeding period was replicated. Does were managed as one group in a pasture-based system, except during mating, and supplemented with concentrate (1.5% BW) during late gestation and lactation. Kids were weaned at 9 wk. Pregnancy was determined on d 1 and 21 after the end of breeding. Data were analyzed in a model that included dam breed, sire breed, and breeding season. Pregnancy rates were 88.3, 13.0, and 64.4% for November, July and March breeding ($P<0.01$), respectively, and were not affected by dam breed. Kidding rates were lower ($P<0.05$) in Myotonic (42.7%) than Spanish dams (63.6%) for March breeding, but similar between dam breeds for November and July breeding. Litter size at birth was greater ($P<0.01$) for November (1.96) than July (1.78) and March (1.70) breeding, and Myotonic dams had smaller litters for March breeding than Spanish dams (1.56 vs. 1.84; $P<0.05$). Litter birth weight was lower ($P<0.05$) for March (4.87 kg) than November (5.51 kg) and July (5.41 kg) breeding. Litter birth weight was heavier in Spanish dams when sired by Boer bucks, while they were heavier in Myotonic dams when sired by Kiko bucks (dam by sire breed: $P<0.05$). Litter ADG and 60-d adjusted weaning weight were greater ($P<0.05$) in Spanish (205 g/d and 18.1 kg) than Myotonic dams (165 g/d and 14.1 kg), and when sired by Kiko (205 g/d and 17.4 kg) than by Boer bucks (164 g/d and 15.2 kg). Spanish does (44.3 kg) were heavier ($P<0.001$) than Myotonic does (34.7 kg), however, litter weight weaned as % doe weight was similar between dam breeds, but higher for November (46.7%) than July (39.6%) breeding, with March intermediate (42.0%). Data indicate that Spanish and Myotonic dams were not well suited for a pasture-based accelerated mating system due to low conception rates following July, and increased pre-natal losses following March breeding.

Key Words: Goats, Kidding Performance, Accelerated Breeding

T165 Effects of alfalfa hay and/or concentrate diets on growth, organ mass, blood and muscle metabolites, and volatile fatty acids in Boer × Spanish male kids. B. Kouakou*, G. Kannan, J. H. Lee, and T. H. Terrill, *Agricultural Research Station, Fort Valley State University*, *Fort Valley, GA*.

Weaned kids (BW = 18 ± .8 kg; n = 36) were used to determine the effect of alfalfa hay, concentrate, or concentrate following hay feeding on performance, organ mass, metabolites and ruminal volatile fatty acids. Kids were stratified by BW, housed in 9 pens (4 kids/pen), with free access to water. Ground alfalfa (Medicago sativa) cube hay or an 18 % CP concentrate diet were fed during two periods of 45 d each. During the first period, two groups of kids (6 pens) were fed hay alone, and one group (3 pens), the concentrate diet. During the second period, one of the hay-fed groups (3 pens) was switched to the concentrate, while the other groups remained on the previous diets. Dietary treatments were HH (Hay, Hay), HC (Hay, Concentrate) and CC (Concentrate, Concentrate) for first and second period diets, respectively. Weights and blood samples were taken every 45 d. At the end of the second period (d 90), all animals were moved to the meat processing facility for overnight holding (water available but without feed). At slaughter, reticulo-rumen and intestines (with and without digesta), and liver weights were recorded. Rumen fluid was collected. Blood samples were analyzed for glucose. Liver and muscle samples were analyzed for glycogen. Proportions of propionate, butyrate, and isovalerate and blood glucose increased with concentrate finishing while proportion of acetate, and acetate:propionate ratio increased with hay finishing. Liver and muscle glycogen concentrations were not influenced by diet. Final weights were lower ($p < 0.001$) for kids fed hay (21.5 and 22.7 kg for HH and HC) compared to those fed concentrate (30.3 kg). Ruminal ammonia was lower ($p < 0.001$), but intestinal and ruminal pH was higher ($p < 0.001$) in goats finished on hay. Liver, rumen (g and % BW), and small intestine (g not % BW) increased ($p < 0.001$) with concentrate feeding. Concentrate finishing increased weight (% BW) of liver and rumen but not the small intestine. Starting weaned kids on alfalfa cube hay and finishing on concentrate for only 45 d may not add benefit in terms of weight gain.

Key Words: Goat, VFA, Glucose, Organs

T166 The effect of mixed species grazing management on forage yield and quality. Y. Ghebreiyessus*, V. Bachireddy, S. Gebrelul, R. Payne, and M. Berhane, *Southern University*.

Cow calf production is one of the major sources of income for small farmers in Louisiana. Goat production has great potential to be an alternative source of income. A study to evaluate the effect of mixed species grazing systems on the forage yield and quality was conducted. Animals were grazed on Bermuda grass pastures during the summer and ryegrass during the winter. In a 3×2 factorial, 80 Spanish goats and 28 Brangus cows were randomly assigned to continuous or rotational grazing systems, and three grazing schemes (goat-alone, cattle-alone or mixed). A land area of 28 ha on Bermuda grass was divided into six pastures, 8 ha each for mixed-species grazing, 2 ha each for goats-alone grazing and 5.5 ha each for cattle-alone grazing. The rotational pastures were further divided, using electric fences, into four paddocks. Each paddock was grazed for seven days and allowed to rest for approximately 21 days. Soil samples were collected and based on soil test results, lime and fertilizers 8-24-24 in fall and ammonium nitrated in spring were applied. Forage samples were collected weekly to determine plant height, forage yield and forage quality. Animals were weighed every 28 days. Based on two years data significant difference in forage yield was found among species and species by grazing interaction ($P<0.05$). Yield ranged from 972 to 1,030 kg/ha. Grazing systems did not show significant differences but yield from rotational grazing was higher than continuous. Yield difference between years and among months was highly significant, ranging from 410 to 1,895 kg/ha. Plant height was significant for grazing and species interaction. Lowest plant height of 18 cm was obtained from cattle alone under rotational grazing and highest of 22 cm was from mixed species under rotational grazing. Crude protein varied significantly between years, among months and species and grazing interaction (8.4 to 11.7%, $P<0.05$). ADF values ranged from 37.6 to 38.3% and were significant with all treatments. NDF values ranged from 41.2 to 60.2% and were significant with species and months interaction.

Key Words: Cattle, Forages, Goats

T167 Abundance of mRNA expression and nutritional regulation of somatotropic axis genes in the small intestine of prepubertal dairy heifers fed high-protein high-fat milk replacers. B. T. Velayudhan*, K. M. Daniels, M. L. McGilliard, B. A. Corl, K. F. Knowlton, and R. M. Akers, *Virginia Polytechnic Institute and State University*, *Blacksburg*.

Components of the somatotropic axis and nutrition are important in regulating intestinal development as well as maturation of enterocytes. We measured the abundance of mRNA by real-time polymerase chain reaction to test the hypothesis that increased amounts of protein and fat in the diet alters the expression of somatotropic axis genes in the mucosal layer of small intestine. We measured the expression of growth hormone receptor (GHR), insulin-like growth factor-I (IGF-I), IGF-I receptor (R) and IGF binding proteins (BP) -1 to -6 in duodenum, jejunum and ileum. Twenty-four newborn Holstein heifers were randomly assigned to one of 4 milk replacers (MR; n=6/diet): MR 1 was 24 % protein and 17 % fat, MR 2 was 32:17, MR 3 was 31:24 at low level of feeding or MR 4 was 31:24 at high level of feeding. Animals were sacrificed and intestinal tissues were harvested for RNA isolation at 59±2 d. Abundance of mRNA for GHR, IGFBP-3, -4, and -5 was greater (1.8, 2.6, 3.0, 1.7 fold, respectively; P≤0.05) in high protein groups compared to the low protein group (MR 2 +MR 3 + MR 4 VS. MR 1) while GHR, IGFBP-2, -3 and -5 mRNA was greater (0.8, 1.7, 1.6, 1.6 fold, respectively; P≤0.05) with high fat feeding (MR 1 + MR 2 VS. MR 3 + MR 4). Abundance of mRNA expression for IGF-I, IGF-IR, IGFBP-3, -4 and -6 was greater (P≤0.05) in duodenum than jejunum or ileum but IGFBP-2 mRNA expression was greater (P≤0.05) in jejunum than duodenum or ileum. However, mRNA expression for GHR, IGFBP-1 and -5 was not different (P≥0.50) between different intestinal locations. In conclusion, components of the somatotropic axis in prepubertal dairy heifers are differentially expressed in regions of the small intestine and the gene expression is impacted by dietary protein and fat.

Key Words: Prepubertal Heifer, Intestinal Mucosa, GH-IGF Axis Gene Expression

T168 Effect of zilpaterol on cultured bovine satellite cells. E. K. Sissom*[1], D. A. Yates[2], J. L. Montgomery[2], W. T. Nichols[2], M. N. Streeter[2], J. P. Hutcheson[2], and B. J. Johnson[1], [1]*Kansas State University*, *Manhattan*, [2]*Intervet Inc.*, *Millsboro, DE*.

Zilpaterol is a β-adrenergic receptor (β-AR) agonist recently approved to improve production efficiencies and dressing percentage in feedlot cattle. The purpose of these experiments was to determine the effect of various levels of zilpaterol (0, 100 pM, 1 nM, 10 nM, 100 nM, 1 μM, and 10 μM) in culture media on bovine satellite cell proliferation and gene expression. Total RNA was isolated from cells following 48 h zilpaterol exposure in both proliferating myoblast cultures at 96 h, and fused myotube cultures established after 192 h in culture. Real-time quantitative-PCR was performed to estimate mRNA abundance. There was no effect (P > 0.10) of zilpaterol dose on [^{3}H]-thymidine incorporation in proliferating myoblasts. Zilpaterol (1 μM) addition to myoblasts resulted in a decrease (P < 0.05) in β1-AR mRNA. Similarly, zilpaterol (10 nM and 1μM) decreased (P < 0.05) β2-AR and β3-AR mRNA. The expression of IGF-I mRNA was increased (P < 0.05) with zilpaterol (1 μM) addition, and there was a tendency (P = 0.07) for zilpaterol (1 nM) to increase myosin heavy chain mRNA, while 10 nM and 1μM zilpaterol reduced (P < 0.05) myosin heavy chain mRNA levels. There was no effect (P > 0.05) of zilpaterol dose on the expression of genes analyzed in fused myotube cultures at 192 h. Similar to changes in mRNA, western blot analysis revealed the protein content of β2-AR in zilpaterol-treated myoblast cultures decreased (P = 0.05) relative to control. Similar to previous work with other β-adrenergic agonists, zilpaterol did not alter satellite cell proliferation but reduced both mRNA and protein levels of the various subtypes of β-AR in these cultures. The response of zilpaterol on IGF-I mRNA could be mediating changes in protein synthesis and degradation. These data indicate that zilpaterol addition can alter mRNA and protein concentrations of β-AR of muscle cell cultures which in turn could impact responsiveness of cells to prolonged zilpaterol exposure.

Key Words: β-Adrenergic Receptor, Skeletal Muscle, Zilpaterol

T169 Cloning and expression pattern of bovine adipogenin isoform. S. G. Roh*, T. Satoh, and S. Shinichi, *Shinshu University*, *Minamiminowamura, Nagano-ken, Japan*.

The generation of new adipocytes results from differentiation mediated by several transcription factors identified as master regulators for adipogenesis. Recently, we reported that adipogenin, a new adipose-specific gene, was highly expressed in adipose tissues and up-regulated during adipocyte differentiation in bovine and mice. In the process of analyzing the expression of adipogenin in adipose tissues from cattle, we found an isoform of adipogenin cDNA, generated by alternative splicing. Therefore, the objective of this study was to isolate of bovine adipogenin isoform and analyze its expression on adipose tissue and differentiated adipocytes. The putative complete coding sequence of the bovine adipogenin isoform gene is 384 bp in length. The splicing event results a new ORF that could generate an isoform of 127 amino acids. Alignment analysis using BLAST program (NCBI) with bovine genomic (chromosome 13 contig NW_001493160) and cDNA adipogenin isoform sequences indicates that flanking nucleotides of divergence point among sequences of this 133 bp fragment and adipogenin cDNA perfectly match with exonic sequences from exon 1/intron 1 and intron 2/exon 3 junctions, confirming that entire exon 2 is spliced in the another fragment. To amplify specifically the adipogenin isoform, we performed RT-PCR analysis using adipogenin isoform-specific forward primer derived from exon 1/exon 3 junction. Total RNA was extracted from bovine tissues and cultured preadipocytes and differentiated adipocytes in 6-well culture dishes, and cDNA synthesis and PCR reactions were performed. The expression of bovine adipogenin isoform mRNA in adipose tissues was significantly higher (P < 0.05) than that in non-adipose tissues examined. The expression of adipogenin isoform was signficantly highly expressed in adipocytes (P < 0.05) compared to stromal-vascular cells. The levels of bovine adipogenin isoform mRNA significantly increased (P < 0.05) throughout the 10-day of adipocyte differentiation. In conclusion, this spliced form of adipogenin may be another factor in the regulation of adipocyte gene expression and in the adipogenic process.

Key Words: Cattle, Adipogenin, Adipogenesis

T170 Δ^9 Desaturase gene expression in adipose tissues of calf-fed and yearling-fed Steers. M. A. Brooks*[1], C. W. Choi[2], D. K. Lunt[1], H. Kawachi[3], and S. B. Smith[1], [1]*Texas A&M University*, *College Station*, [2]*National Livestock Research Institute*, *Suwon, South Korea*, [3]*Kyoto University*, *Kyoto, Japan*.

There is a growing interest in documenting the effect diet on the ability to convert saturated fatty acids (SFA) to monounsaturated fatty acids (MUFA) by modulating expression of the Δ^9 desaturase gene. We propose that if cattle were raised to a constant body weight, their MUFA:SFA ratio will be the same regardless of being calf-fed (CF) or yearling-fed (YF). Twenty-four Angus cattle were acquired for this study. Baseline cattle were slaughtered at weaning at 8 mo of age (n=4), and the remaining cattle were assigned to CF and YF groups. Eight steers were assigned to the CF group and were slaughtered at 12 mo of age (n=4) and 16 mo of age (n=4). Twelve cattle were assigned to the YF group and slaughtered at 12 mo of age (n=4) 16 mo of age (n=4) and market weight of 525 kg (n=4). Intramusclar lipid (IML) of the LM, fatty acids of s.c. and i.m. adipose tissues, slip points of the s.c. lipids, and mRNA concentrations were measured in adipose and muscle samples of each of the cattle in the study. As the animals aged, a significant rise was seen in IML of both CF ($P<0.01$) and YF ($P<0.01$). Slip points (estimators of melting points) in both CF animals and YF animals significantly decreased with age; however, there was no significant difference in slip points between the 16 mo CF cattle and market weight YF cattle (difference of 1.95°C, $P=0.25$). The s.c. adipose tissue Δ^9 desaturase gene expression was virtually undetectable in both the baseline and 12 mo old YF animals, whereas there was marked expression in all the CF and the other YF cattle. This observation was confirmed by the s.c. adipose tissue MUFA:SFA ratios. The baseline and 12 mo old YF animals showed similar ratios (0.770, 0.707, respectively), whereas there was a significant increase from baseline in the animals that were being fed grain diets (CF 1.01 and 1.02, YF 0.98 and 0.96). The results indicate a repression of Δ^9 desaturase gene expression in YF cattle during the first 4 months after weaning, but a pronounced increase in desaturase gene expression by 16 mo of age, which resulted in similar MUFA:SFA ratios by the time the cattle reached market weight.

Key Words: Adipose Tissue, Beef, Fatty Acids

T171 Impact of irradiation and IgG concentration on absorption of protein and IgG in calves fed colostrum replacer. J. M. Campbell*[1], L. E. Russell[1], J. D. Crenshaw[1], E. M. Weaver[1], S. Godden[2], J. D. Quigley[3], J. Coverdale[4], and H. Tyler[5], [1]*APC, Inc.*, *Ankeny, IA*, [2]*University of Minnesota*, *St. Paul*, [3]*Diamond V Mills*, *Cedar Rapids, IA*, [4]*Texas A&M University*, *College Station*, [5]*Iowa State University*, *Ames*.

The objectives of this study were to evaluate the effect of total IgG mass derived from bovine serum fractions (colostrum replacer; CR) and level of irradiation on 24 h serum IgG levels, protein levels, apparent efficiency of absorption (AEA) of IgG, and the ability to prevent failure of passive transfer (FPT) in day old dairy calves. When irradiated, single dose packs of CR were sent to a commercial irradiation facility for electron beam (e-beam) irradiation at 3-7 kGy (low irradiation; L) or 15-20 kGy (high irradiation; H). Sixty-five Holstein, Jersey, or cross-bred calves were randomly assigned to one of six treatments: 1) 2.0 L pooled pasteurized maternal colostrum (MC); 2) 130 g IgG (460 g of CR) no irradiation (130 NR); 3) 130 g IgG (460 g of CR) low irradiation (130 L); 4) 160 g IgG (518 g of CR) low irradiation (160 L); 5) 190 g IgG (575.4 g of CR) low irradiation (190 L); and 6) 130 g IgG (460 g of CR) high irradiation (130 H). All CR were reconstituted in water and mixed in a household blender to a constant solids concentration of 23%. Maternal colostrum was poor quality providing 33.8 g of IgG/2 L dose resulting in 24 h serum IgG of 3.59 g/L which was lower ($P < 0.0001$) than CR treatments. Increasing IgG mass in the CR (130L, 160L, and 190L) resulted in a linear increase in 24 h serum IgG ($P < 0.02$), total protein levels ($P < 0.07$), and a linear decrease in AEA of IgG ($P < 0.05$). There was no effect ($P > 0.10$) of increasing the mass of IgG fed on the percentage of calves with FPT. Increasing irradiation dose to a high of 15-20 kGy (130H) resulted in a linear decrease ($P < 0.05$) in 24 h serum IgG, AEA of IgG, and increased ($P < 0.07$) the percentage of calves with FPT. Correlation between serum IgG and total protein at 24 h was positive; however, irradiation reduced ($P < 0.01$) at 24 h the serum IgG to total protein ratio. Further studies are needed to determine the effects of irradiation on IgG absorption in the neonatal calf. Colostrum replacers providing 130 g of IgG in the first feeding isolated from bovine serum and receiving either no irradiation or a low level of irradiation are sufficient to prevent FPT in calves.

Key Words: Calf, IgG

T172 Relationship between blood serum IGF-1 and GH concentrations and growth of Holstein steers. N. Torrentera*[1], R. Cerda[1], M. Cervantes[1], P. Garcez[2], and W. Sauer[1], [1]*Universidad Autonoma de Baja Cali*, *Mexicali, Baja, California, Mexico*, [2]*Universidad Autonoma de Mexico*, *Mexico*.

Insulin-like growth factor-1 (IGF-1) and GH have been studied as indicators of growth potential in beef cattle, but the relationship between these and the growth and development of Holstein steers has not been reported. The objective of this study was to relate the concentrations of GH and IGF-1 in blood serum and growth of Holstein calves. Twelve calves weaned at 4±2 d, average age and BW of 45 d and 54,6 kg, respectively, were selected to obtain their BW and blood samples every 28 d during 336 d. Ten blood samples were collected at 30 min intervals, from 0800 to 1300 h, every sampling date. Samples from the same animal and sampling day were mixed, and a serum subsample was used to analyze. The concentrations of IGF-1 and GH were analyzed using RIA test. Linear regression and correlation analyses were performed to determine the relationship between ADG and BW, and serum concentrations of IGF-1 and GH. The correlation values between serum IGF-1 and ADG or BW were consistently positive (0.47 and 0.48, respectively), but the correlation values between GH and ADG and BW were negative (-0.31 and -0.37, respectively). Serum concentration of IGF-1 explained 24% of the variation in ADG, but GH only explained nearly 10% of this variation. There was a significant relationship ($P < 0.01$) between serum IGF-1 and age of the calves. Serum concentration of IGF-1 showed a strong relationship with BW ($R^2 = 0.41$) throughout a 336 d postweaning growth performance. These data indicate that serum IGF-1 may be useful for predicting average daily gain in Holstein steers.

Key Words: Holstein Steers, IGF-1, GH

T173 Serial slaughter evaluation of growth-promoting implants on growth and carcass characteristics in calf-fed Holstein steers. J. L. Beckett*[1], L. D. Luqué[1], P. D. Bass[3], W. T. Nichols[2], and R. J. Delmore[1], [1]*California Polytechnic State University*, *San Luis Obispo*, [2]*Intervet Inc.*, *Millsboro, DE*, [3]*Colorado State University*, *Fort Collins*.

Growth and carcass characteristics of calf-fed Holstein steers implanted with and without growth-promoting implants were evaluated during a serial harvest study. A total of 120 steers (average initial weight = 127 kg) were randomly assigned to either receive implants (I; Syn C at d 0, Rev IS at d 120, and Rev S at d 240) or nonimplanted control (C). Steers were fed a finishing ration continuously from day 0 through 420. Steers were weighed every 30 days from day 0 through 420 days on feed. A total of 8-12 head per treatment group were harvested on days 0, 60, 120, 180, 240, 270, 300, 330, and 420. Data collected included HCW, REA, skeletal maturity, marbling score and fat thickness. Yield grade was calculated and quality grade was determined. By 90 d, I cattle were significantly heavier than C cattle. Average shrunk weights for I cattle were 137, 172, 214, 261, 314, 354, 410, 458, 489, 534, 580, 627, 660, and 695 kg compared with 137, 168, 208, 249, 295, 330, 372, 417, 445 481, 509, 547, 567, 570, and 597 kg for C cattle on days 0, 60, 120, 180, 240, 270, 300, and 420, respectively. Average HCW of I cattle was 19, 32, 39, 47, 59, and 56 kg heavier on day 120, 240, 300, 330, 360, and 420, respectively ($P<0.05$). Dressing percent increased linearly ($P<0.05$) from 53% on day 0 to 62% by d 420, but did not differ by treatment. Fat thickness was not significantly different between the treatments throughout the feeding period ($P>0.05$). I cattle tended to have larger REA than C cattle on days 120, 300, 360 and 420, but the effect was not significant ($P>0.05$). Average REA increased from 26 cm^2 on day 0 to 87 cm^2 on day 420. Marbling score tended to be greater for C cattle on days 120, 180, 270, 300 and 360 ($P>0.05$). Results of this study confirm that growth-promoting implants are effective throughout the growing period in calf-fed Holstein steers. Further, each successive implant is additive to prior growth enhancement.

Key Words: Holstein, Growth Promoters, Serial Harvest

T174 The effect of milk replacer composition on growth and body composition of Holstein heifer calves. S. R. Hill, K. M. Daniels*, K. F. Knowlton, R. E. James, R. E. Pearson, M. L. McGilliard, and R. M. Akers, *Virginia Polytechnic Institute and State University*, *Blacksburg*.

Twenty-four newborn Holstein heifer calves (n=6) were fed one of 4 milk replacers: 20/20 (fed at 450 g/d, 20% CP/ 20% Fat, 0.53% P); 28/20 (fed at 970 g/d, 28% CP/ 20% Fat, 0.55% P); 28/28 (fed at 970 g/d, 28% CP/ 28% Fat, 0.46% P); or 28/28+ (fed at 1460 g/d, 28% CP/ 28% Fat, 0.46% P). Calves were purchased from a commercial farm at 3±2 d and arrived in one of three groups. Treatments were assigned randomly within group. Calves were fed 3.4 L of colostrum twice within 16 h of birth. Upon arrival at the research farm, calves were fed a 20/20 milk replacer for the first two feedings. On d 3, treatments were imposed and calf starter (20% CP, 0.48%P) comprised of corn (44.4%), soybean meal (44.4%), cottonseed hulls (11.1%), and molasses (1.0%) was offered free choice. Calves were on study for ~63 d. Total collection of feed refusals, feces and urine was initiated on d 59±2d. Body weight and body size were measured weekly. Calves were harvested at 63 d to evaluate body composition and mammary development (reported elsewhere). Preplanned contrasts were used to compare 20/20 to all, 28/20 to 28/28, and 28/28 to 28/28+. Empty body weight (EBW) gain was greater in calves fed 28/28+ compared to 28/28, however those same calves also had a higher percent of EBW as fat. Calves fed 28/20 had the most protein gain compared to those fed extra energy (28/28) and also had a higher protein as a percent of EBW. The addition of fat to the milk replacer reduced protein gain (kg and % of EBW), increased fat gain (kg and % of EBW), and decreased ash gain (kg and % of EBW). Increasing the volume fed did increase protein gain, fat gain (kg and % of EBW) and ash gain. These results indicate that 20% fat may not be enough energy to support protein gain when CP is greater than 28% of the diet DM. However, frame growth appeared to increase when calves were fed the 28/20 compared to 28/28, indicated by increased ash gain and increased body measurements.

Key Words: Milk Replacer, Calf, Body Composition

Immunology - Livestock and Poultry II

T175 Long-term consumption of resistant starch reduces T cell population and apoptosis in pig colon. M. Nofrarías*[1,2], D. Martínez–Puig[2], J.F. Pérez[2], and N. Majó[1,2], [1]*Centre de Recerca en Sanitat Animal (CReSA)*, *Bellaterra, Spain*, [2]*Universitat Autònoma de Barcelona*, *Bellaterra, Spain*.

The aim of the present study was to assess the effects of a long-term intake of resistant starch on the colonic fermentation and intestinal morphology, including lymphocytic infiltration, apoptosis and proliferation activities. Sixteen growing pigs were fed for 14 weeks on a diet containing a high amount (350 g/kg) of either raw potato starch (RPS; resistant starch type II) or corn starch (digestible starch). On day 97, pigs were euthanised and the gut weighed and sampled. Colonic digesta were analysed for short chain fatty acids concentration. Histological study was performed in tissue samples from proximal colon. The presence of T cells, cells undergoing apoptosis, and proliferative activity were also immunohistochemically determined. After 97 days, the colonic content from RPS pigs was heavier than for CS pigs (1.52 vs. 3.04 kg; $P<0.01$), producing a hypertrophy of tunica muscularis (428 vs. 529 µm; $P<0.01$). The concentration of butyrate was 3-fold higher in proximal colon digesta in RPS pigs (5.86 vs. 16.30 µmol/g; $P=0.02$). RPS fed pigs had reduced crypt depth (429 vs. 416 µm; $P=0.045$) and tended to diminish crypt cell proliferation (35.7 vs. 32.5 cells; $P=0.09$). Fermentation of RPS reduced ($P<0.05$) apoptosis, as number of immunopositive cells for cleaved caspase-3, in the crypts (0.62 vs. 0.32/crypt), lamina propria (1.41 vs. 1.16/1000 μm^2) and lymphoid nodules (5.9 vs. 3.9/1000 μm^2) in the colon. The numbers of intraepithelial T CD3+ cells (6.1 vs. 5.6/crypt; $P=0.027$) and the presence of mucosal lymphoid nodules (0.094 vs. 0.037/mm; $P=0.09$) were also reduced in the colon of RPS pigs. Results in colonic lymphocytic infiltration and apoptosis suggest that long term ingestion of RPS could induce lower immune reactivity in the hindgut.

Key Words: Resistant Starch, Intestinal Apoptosis, Pigs

T176 Utilization of alfalfa and its effects on the immune system during molt. J. L. McReynolds*, K. J. Genovese, H. He, C. L. Swaggerty, J. A. Byrd, D. J. Nisbet, and M. H. Kogut, *USDA-ARS-SPACR-FFSRU*, *College Sation, TX.*

Force molting of laying hens increases enteric foodborne pathogens in the reproductive tract, leading to contaminated eggs and progeny of infected hens. Currently, we lack a complete understanding of how conditions such as molting affect the immune system. Our laboratory is interested in continuing research on feeding alfalfa during a molt to evaluate its effects on heterophils function. Previous reports show that alfalfa is effective in inducing a molt as well as producing protection against *Salmonella enteritidis* (SE) organ invasion. Our laboratory has also shown that immune function is significantly reduced during molting. The present investigation was performed to evaluate heterophil function during an induced molt in hens fed alfalfa. Two replicate experiments utilized hens over 65 wk of age that were divided into 6 groups of 12 hens each and placed in individual laying cages. Two wk prior to dietary changes, hens were placed on an 8-h light and 16 h-dark photoperiod that continued for the 12-day experiment. Blood samples were taken from the hens during three sampling periods, 1-2d, 5-6d, and 11-12d. Treatments groups consisted of non-fed hens (NF), full-fed hens (FF) and alfalfa-fed hens (AF). Heterophil function was measured using several in vitro assays. We evaluated oxidative burst, degranulation, and phagocytosis. The results from the oxidative burst and degranulation assays showed significant ($P \leq 0.05$) increases when the AF birds were compared to the NF controls. Phagocytosis assays showed AF birds had similar net increases to FF birds when compared to the negative control. These results confirm that heterophil function is significantly reduced in NF birds during an induced molt. More importantly AF birds showed an increased immune response during a 12d molting period. Commercial integrators should consider using alfalfa when developing new molting programs.

Key Words: Chickens, Molting, Heterophils

T177 Effect of a direct fed microbial (PrimaLac®) on systemic immunity in developing broilers. C. C. Chiang[1], R. Qiu[2], J. Croom[2], L. Daniel[2], R. Ali[2], and M. Koci*[2], [1]*National Chung Hsing University*, *Taiwan*, [2]*North Carolina State University*, *Raleigh*.

Consumer and political concerns over the sub-therapeutic use of antibiotics in has led an interest in identifying alternative growth promoting dietary supplements such as direct fed microbials (DFM). DFM supplements have been used for decades to promote animal and human health however their mechanism of action is still unclear. The current study investigated the effects of DFM treatment on systemic immune responses in broiler chicks. Day-old broiler chicks were fed a control starter diet (CSD), or CSD plus PrimaLac® (PRM; 0.3% w/w). Each diet group was randomly divided into two treatment groups, one vaccinated i.v. with sheep red blood cells (SRBCs); the other mock vaccinated with normal saline (SAL). Chicks were vaccinated at 7 and 14 days of age, and monitored for the production of antibodies (Abs) against SRBCs by hemagglutination assay. Chicks fed the PRM diet produced higher titers of both total and β-mercaptoethanal resistant anti-SRBCs Abs as compared to the CSD group. Additionally, ex vivo stimulation of macrophages (Mϕ) isolated from PRM and CSD chicks demonstrated an increase in nitric oxide production by Mϕ from PRM treated chicks. Ex vivo analysis of circulating peripheral blood leukocytes (PBLs) suggested ATP utilization of PBLs from PRM-SAL chicks was lower than that of CSD-SAL chicks. However, the ATP utilization of PRM-SRBC chicks was greater than that of CSD-SRBC chicks. This suggests that while DFM may promote a more robust immune response, it may also be able to lower the maintenance cost of leukocytes in resting animals. Further investigation is needed to better understand this association.

Key Words: Probiotic, Direct fed Microbial, Immunity

T178 Effects of yeast culture in broiler diets on performance and immunomodulatory functions. J. Gao[1], H.-J. Zhang[1], S.-H. Yu[1], S.-G. Wu[1], I. Yoon[2], J. Quigley[2], and G.-H. Qi*[1], [1]*Feed Research Institute, Chinese Academy of Agricultural Sciences*, *Beijing, China*, [2]*Diamond V Mills, Inc.*, *Cedar Rapids, IA*.

Abor Acres chicks (n = 960, 1 d old) were randomly assigned to 4 dietary treatments with different levels (0, 2500, 5000 and 7500 mg/kg of the diet) of a commercial yeast culture product (Diamond V XP™ Yeast Culture; YC) to investigate the effects of YC on performance and immunomodulatory function in broilers. Broilers were housed in a three-layer batteries and fed corn-soybean meal based diets for 42 d. Each treatment consisted of 12 replicate pens with 20 broilers per pen. Feed intake and body weight were measured on d 1, 21 and 42. Nutrient digestibility was determined at 2 and 5 wk by total fecal collection. On d 21 and 42, twelve broilers per treatment were sacrificed for gut morphology and immune function measurements. Broilers were vaccinated with Newcastle Disease Virus (NDV) by eye drop on d 7 and 21 and antibody titer was determined on d 14, 21, 28, and 35. Compared with the control group, including YC at 2500 mg/kg improved ($P < 0.05$) ADG and feed efficiency on d 22-42 and 1-42. Yeast culture supplementation did not affect ($P > 0.05$) ADFI. Supplemental YC tended to increase ($P < 0.1$) digestibility of Ca on d 14 and 35 and P on d 14, but did not affect ($P > 0.05$) digestibility of energy, protein, and DM at 14 and 35 d. Added YC increased ($P < 0.05$) antibody titers to NDV on d 14, 21, 35 and 42. Dietary YC increased ($P < 0.05$) serum lysozyme activity and IgM content on d 21 and 42 but did not affect ($P > 0.05$) serum IgA or IgG on d 21 and 42. Added YC increased ($P < 0.01$) secretary IgA content in duodenum on d 21 and 42. Villus height of duodenum, jejunum, and cecum on d 21 and duodenum on d 42 were increased ($P < 0.05$) for broilers fed diets containing 2500 mg/kg of YC. Results suggest that supplementation of YC in broiler diets can improve growth performance, increase the calcium and phosphorous digestibility, and intestinal villus height. Immune functions could be modified with the inclusion of YC in the broiler diet.

Key Words: Immune Function, Yeast Culture, Broiler

T179 Dietary polyunsaturated fatty acids modulate immune responses in dairy cows characterized by an elevated plasma trans-10, cis-12 CLA and n-3 fatty acids but not cis-9, trans-11 CLA. M. Bharathan*, D. J. Schingoethe, R. S. Kaushik, K. F. Kalscheur, G. Moorkanat, and A. Hippen, *South Dakota State University*, *Brookings*.

Fatty acid composition of the diet can affect the membrane fatty acid composition of immune cells resulting in altered membrane-mediated

functions like eicosanoid production and signal transduction. To study the effect of dietary fatty acids on immune response, 12 lactating Holstein dairy cows were randomly assigned to one of four dietary treatments which included control (CTRL), control with 0.5% fish oil (FO), 10% condensed corn distillers solubles (CCDS), and 10% CCDS with 0.5% fish oil (CSFO). Cows were fed individually as total mixed ration once daily for ad libitum consumption for 28 d. Blood samples were collected on d 0, 7, 14, 21 and 28 to isolate peripheral blood mononuclear cells (PBMC) for proliferation assays and phenotypic characterization of bovine leukocyte markers, and whole plasma for analysis of fatty acid composition. Results indicated that feeding of these diets did not affect proliferation of lymphocytes but percentages of CD4+ and CD8+ T-cells decreased, CD14+ cells increased and MHC class II+ cells tended to increase in cows fed CSFO compared to CTRL. In this experiment, total fatty acids in the plasma did not differ due to diet, while total n-3 fatty acids in the plasma (102.9, 135.9 117.9 and 162.2μg/mL of plasma for CTRL, FO, CDS and CSFO, respectively) increased ($P < 0.01$) in CSFO and tended ($P < 0.09$) to increase with FO compared to CTRL. Cis-9, trans-11 C18:2 (conjugated linoleic acid; CLA) in plasma did not differ among diets; however, trans-10, cis-12 C18:2 CLA increased ($P < 0.02$) in CSFO compared to CTRL. Trans-11 C18:1 concentration (8.6, 15.6, 15.0 and 27.8 μg/mL of plasma) increased ($P < 0.01$) in cows fed CSFO while trans-10 C18:1 remained unaffected. Thus a diet rich in polyunsaturated fatty acids appears to decrease cell mediated immunity, but it may increase the innate immune responses and antigen presentation.

Key Words: Polyunsaturated Fatty Acids, Dairy Cows, Immune Response

T180 Plasma prostaglandin and cytokine concentrations in periparturient Holstein cows fed diets enriched in saturated or trans fatty acids. C. Rodriguez-Sallaberry*, C. Caldari-Torres, W. R. Collante, C. R. Staples, and L. Badinga, *University of Florida*, *Gainesville*.

Multiparous (n = 18) and primiparous (n = 12) Holstein cows were utilized to examine the effect of feeding a calcium salt of trans octadecenoic acids (tFA) on plasma prostaglandin (PG) and cytokine concentrations. The control diet was made isocaloric by addition of a highly saturated fat supplement (RBF). Dietary treatments were initiated approximately 28 d prior to expected calving date and continued through d 21 postpartum. Prepartum and postpartum diets were formulated to be isolipidic, containing 1.5% RBF and 1.8% tFA (DM basis). Multiparous cows were heavier (+ 32%) and tended to produce more milk (+ 15%) than primiparous cows. Average plasma NEFA concentration was higher in multiparous cows (+ 70%) than first lactation heifers at 3 wk of lactation. Periparturient tFA supplementation increased plasma $PGF_{2\alpha}$ metabolite (PGFM) concentration in multiparous cows, but not in primiparous cows. Concentrations of PGE_2, tumor necrosis factor-alpha (TNF-α) and interleukin-4 (IL-4) in plasma did not differ between diets and parities. Peripartum tFA supplementation tended to decrease the incidence of postpartum metritis in lactating Holstein cows. Results further confirm that multiparous cows are heavier and produce more milk than first-lactation heifers and raise the possibility that peripartum tFA supplementation may improve the immune competence of the early lactation dairy cow through alteration of peripheral $PGF_{2\alpha}$ concentration.

Key Words: Fat, Cytokine, Dairy Cow

T181 Natural antibody (anti-gal) is a sensitive means for evaluating the effects of diets on turkey humoral immunity. P. Cotter*[1], M. Hulet[2], and A. E. Sefton[3], [1]*Cotter Laboratory*, *Arlington, MA*, [2]*The Pennsylvania State University University*, *University Park*, [3]*Alltech Inc.*, *Guelph, ON, Canada*.

The influence of dietary supplements and growth promoters on immunity in turkeys was studied in serum from four groups of hens. Samples were obtained on d 84 from 10 hens each on two diets and hatched from two breeder flock sources. Diets contained 4% NuPro® in pre-starter and 2% in starter, or penicillin in starter. Natural antibodies reactive with the α-gal epitope (Galα1-3Galβ1-4GlcNAc-R) were detected by rabbit cell agglutination. A strongly agglutinating (HA1) pattern may be differentiated from a minority of weakly agglutinating (HA2) antibody by distinctive clumping. HA1 are presumably predominated by IgM whereas HA2 are IgG. Collectively anti-gal is the most abundant antibody in avian serum and is formed as a response to gut microflora. Microtiter results indicated a significant diet x origin interaction ($P > 0.01$) for HA1 the IgM antibody, but not for HA2. HA1 titers were higher in penicillin fed hens than in NuPro® fed hens from one origin but lower in penicillin fed hens from the second origin. Total IgM, measured by immunodiffusion, indicated a significant effect of breeder flock origin ($P > 0.03$) but there was no diet effect. Complement lysis and IgG agglutination were not affected by diet or breeder flock origin. The immunity parameters of HA1 and total IgM mirrored performance measurements of BW, BWG, feed intake, and feed conversion ($P < 0.0001$) as being affected by origin but not by diet. Poults sourced in VA had lower BWG and lower feed intake which paralleled their lower IgM agglutination titers and lower total IgM. MN sourced poults fed Penicillin had higher IgM agglutination compared with NuPro® fed poults but the reverse was true for poults sourced in VA. The mechanism exerting the source effect is unknown but may lie in yolk composition, perhaps acting via maternal antibody. These might determine gut flora establishment and so account for antibody variation. Thus anti-gal sensitivity indicates its utility as an immunity adjunct in nutritional studies in the turkey.

Key Words: Anti-Gal, Turkey Immunity, Growth Promoters

T182 Effects of feeding blends of grains naturally contaminated with Fusarium mycotoxins on immunocompetence of turkeys. C. K. Girish*, T. K. Smith, H. J. Boermans, and N. A. Karrow, *University of Guelph*, *Guelph, Ontario, Canada*.

An experiment was conducted to examine the effects of feeding blends of grains naturally contaminated with Fusarium mycotoxins on immunological indices (including functions) of turkeys. The efficacy of polymeric glucomannan mycotoxin adsorbent (GMA, Mycosorb®, Alltech, Inc., Nicholasville, KY) in preventing the adverse effects of Fusarium mycotoxins was also evaluated. Three hundred 1-d-old male turkey poults were fed wheat, corn and soybean meal-based starter (0-3 wk), grower (4-6 wk), developer (7-9 wk), and finisher (10-12 wk) diets formulated with uncontaminated grains, contaminated grains and contaminated grains + 0.2 % GMA. Feeding contaminated grains to turkeys significantly increased percent CD4+ lymphocyte populations during wk 6, however there was no change in the percent CD8+ and B-lymphocyte populations. Contact hypersensitivity to dinitrochlorobenzene, which is a CD8+ T-cell-mediated delayed type hypersensitivity response, was significantly decreased after 24 hr and 72 hr by feed-borne mycotoxins compared to controls. Supplementation of the contaminated diet with GMA prevented the decrease in response

after 24 hr. Mitogenic responsiveness of peripheral lymphocytes to concanavalin A and pokeweed was not affected by the feeding of contaminated diet. The feeding of contaminated grains did not significantly alter the serum (IgA, IgM and IgG) or bile (IgA) immunoglobulin levels. In contrast, the secondary antibody (IgG titer) response against sheep red blood cell antigens (CD4+ T cell dependent) was significantly decreased after feeding contaminated grains to turkeys compared to controls and GMA prevented this. It was concluded that the feeding of grains naturally contaminated with Fusarium mycotoxins exerts adverse effects on some of the immunological indices of turkeys and that GMA prevented many of these effects.

Key Words: Fusarium Mycotoxin, Antibody-mediated Immune Trespons, Turkeys

T183 Phage display selection and characterization of single-chain recombinant antibodies against *Eimeria tenella* sporozoites. D. Abi-Ghanem*[1], S. D. Waghela[1], D. J. Caldwell[1], H. D. Danforth[2], and L. R. Berghman[1], [1]*Texas A&M University*, *College Station*, [2]*USDA/ARS*, *Beltsville, MD*.

An antibody library against *Eimeria tenella* sporozoites was constructed by phage display. Total RNA was isolated from the spleen, bone marrow, and ceca of immunized chickens, and was used to reverse-transcribe cDNA. Heavy and light antibody variable genes were amplified from cDNA by PCR. The single-chain antibody fragment (scFv) was obtained by a secondary overlap PCR with primers that incorporate SfiI restriction sites, thus allowing for subsequent cloning into the phagemid vector pComb3X. Vector and scFv were digested with SfiI, ligated, and transformed into competent XL1-Blue *Escherichia coli* cells by electroporation, yielding a library of 7.4 x 10^7 total transformants. The culture was grown under carbenicillin selective pressure, rescued with helper phage, and the antibody-displaying phage was precipitated by PEG/NaCl, and subsequently used in five panning rounds against cryopreserved *E. tenella* sporozoites. Panning on whole cells offered the advantage of isolating antibodies against native epitopes, but required readily available sporozoites for every round of selection. A 1000-fold increase in phage output and a 3,000-fold enrichment were obtained after three rounds of panning, as the binding clones became the dominant population in the library. Ten clones were randomly selected from the last round of panning, and their nucleotide sequences were aligned and compared to chicken germ-line sequences. Analysis of the light chain variable regions revealed possible donor pseudogenes involved in gene conversion events. Possible somatic hypermutation events, a consequence of affinity maturation, were also identified. Soluble antibody was produced in a non-suppressor *E. coli* strain, purified by nickel affinity chromatography, and characterized by immunoblotting. In an immunofluorescence assay, this recombinant antibody showed specific binding to *E. tenella* sporozoites.

Key Words: Phage Display, *Eimeria Tenella*, Single-Chain Antibody

T184 Immune stimulatory CpG oligodeoxynucleotides reduces *Salmonella enterica* subsp. Arizonae organ colonization and mortality in young turkeys. H. He*, K. J. Genovese, C. L. Swaggerty, and M. H. Kogut, *Food and Feed Safety Research Unit, Southern Plain Agricultural Research Center, USDA-ARS*, *College Station, TX*.

Synthetic oligodeoxynucleotides (ODN) containing CpG dinucleotides (CpG ODN) mimics bacterial DNA and are stimulatory to innate immune system in most vertebrate species. The immunostimulatory activities of CpG ODN have been studied extensively and well characterized in human and murine immune cells. However, information on immune responses of avian species to CpG ODN is limited. We have previously investigated immune stimulatory activities of CpG ODN in turkey immune cells. Here, we have further demonstrated that immune stimulatory CpG ODN increases resistance of young turkeys to *Salmonella* infection. In this study, the newly hatched turkeys, obtained from a commercial source, were given CpG-ODNs or a control ODN that does not contain CpG motif at 50 µg/bird via intra-peritoneal (i.p.) injection. Twenty-four hours after the CpG-ODN treatments, turkeys were challenged with live *Salmonella enterica* subsp. Arizonae (SEA) (suspended in PBS). For the organ colonization experiment, 0.5-1x10^7 cfu/bird was given orally to the turkeys. For the mortality experiment, 0.5-1x10^7 cfu/bird was given to the turkey via i.p. injection. Twenty-four hours after the oral SEA challenge, birds were euthanized with CO2 and liver and spleen were aseptically removed from each bird and cultured for the organ colonization of SEA. The mortality was monitored for a period of 7 days after i.p. SEA challenge. A significant reduction ($p<0.05$) of organ invasion by SEA was observed in turkeys pretreated with CpG-ODNs containing the immunostimulatory GTCGTT motif. These CpG-ODNs also significantly reduced mortality of turkeys with acute peritoneal infection of SEA. Our study provides evidence that immunostimulatory CpG-ODN stimulated innate immune activities and enhanced the resistance to infectious pathogens in neonatal turkeys.

Key Words: CpG ODN, Infection, Turkey

T185 Responese of bovine lymphocytes to different CpG motifs. J.-W. Lee*[1] and X. Zhao[2], [1]*National Pingtung University of Science and Technology*, *Neipu, Pingtung, Taiwan*, [2]*McGill University*, *Ste-Anne-de-Bellevue, Quebec, Canada*.

The immunostimulatory effects of bacterial DNA or synthetic CpG oligodeoxynucleotides (ODNs) on mammal cells have been demonstrated, which makes CpG a potential adjuvant for vaccines. However, the immunostimulatory effect of CpG is species-specific and depends on the sequence of CpG mofits. A CpG fragment (2135), containing 3 identical copies of 5′-GTCGTT-3′ motif, was previously reported to have the strongest effects on bovine cells. Based on the sequence of 2135, we replaced the 5′-GTCGTT-3′ motif with 11 other sequences containing CG and investigated their effects on proliferation of bovine peripheral blood mononuclear cells (PBMC). Results showed that the CpG fragment containing 3 copies of 5′-GACGTT-3′ motif had the highest stimulation index (SI) (7.91 ± 1.19). We therefore further examined the effect of this CpG fragment on cytokine expression in bovine PBMC at the transcriptional level by using real-time PCR. Among the 6 cytokines analyzed, the mRNA expression of IL-6, IL-12, IL-21, and IFN-α was increased > 2 fold in response to this CpG fragment. However, the increase was not statistically significant due to large variations among animals. A vaccine trial is currently being carried out to evaluate the antibody response induced by this CpG fragment as the adjuvant.

Key Words: Bovine, Adjuvant, CpG

T186 Effect of dietary P level and pectin infusion on bacterial P incorporation, activity and composition in pigs. B. U. Metzler*[1], W. Vahjen[2], T. Baumgärtel[3], M. Rodehutscord[3], and R. Mosenthin[1], [1]*Institute of Animal Nutrition, University of Hohenheim*, *Stuttgart, Germany*, [2]*Institute of Animal Nutrition, Free University of Berlin*, *Berlin, Germany*, [3]*Institute of Agricultural and Nutritional Sciences Halle-Wittenberg*, *Halle (Saale), Germany*.

Two experiments were conducted to determine the effects of different P levels, phytase supplementation and the intracecal application of pectin on the chemical composition of fecal mixed bacterial mass (MBM), ileal and fecal levels of VFA as well as bacterial species composition. A total of 16 barrows, initial BW of about 30 kg, fitted with a simple T-cannula at the distal ileum, were assigned to 2 experiments in incomplete 4x2 Latin square design. In Exp. 1, the diets were a low-P corn-soybean meal based control diet (Con; 3g P/kg) or the Con supplemented with MCP (monocalcium phosphate; 7g P/kg). In Exp. 2, the pigs received Con or the Con supplemented with 1000 FTU phytase/kg. Additionally, in both experiments, two pigs of each diet and period received an intracecal infusion of pectin (60g/d) via the ileal cannula. After a 15d adaptation, feces were collected for 5d followed by collection of ileal digesta during 2x12h. Counts for total bacteria in ileal digesta and feces and specific bacterial groups in ileal digesta were determined by quantitative realtime PCR. MCP increased the P content in MBM and the proportion of bacterial P in feces (P<0.05), while phytase reduced the P content in MBM (P<0.05). MCP tended (P=0.12) to stimulate the production of total ileal VFA, while pectin tended (P=0.07) to increase fecal VFA. Phytase tended to reduce (P=0.1) total fecal VFA. The interaction pectin x phytase increased (P=0.07) fecal total bacterial counts. MCP tended to reduce (P=0.12) the growth of lactobacilli, while pectin enhanced (P=0.08) the growth of bifidobacteria in ileal digesta. In conclusion, the bacterial P incorporation, fermentative activity and species composition is influenced by both dietary P level and pectin as fermentable substrate.

Key Words: Phosphorus, Pectin, Bacteria

T187 Effects of adding water into the mixer on pellet quality of expander processed barley–oats–soy–based diets for finishing pigs. K. K. Lundblad*[1,2], J. D. Hancock[2], M. Sørensen[3,4], K. C. Behnke[2], E. Prestløkken[1], and L. J. McKinney[2], [1]*Felleskjøpet Fôrutvikling*, *Trondheim, Norway*, [2]*Kansas State University*, *Manhattan*, [3]*University of Life Sciences*, *Aas, Norway*, [4]*AKVAFORSK*, *Aas, Norway*.

A barley-oats-soy-based formula was used to determine the effects of adding water into the mixer on pellet quality of expander-processed diets for finishing pigs. The barley (67% of the diet) and oats (15% of the diet) were ground to a mean particle size of 600 um and blended with soybean meal (9% of the diet), choice white grease (5% of the diet), crystalline amino acids, vitamins, and minerals creating a diet with 0.8% total lysine and 10% total moisture. Treatments were none, 1.5, 3, 6, and 12% water added into the mixer after a 'dry-mix' time of 60 sec. Total mix time was 240 sec. The mixed mash was steam conditioned at 82°C for approximately 20 sec prior to passing through a 100 hp Amandus-Kahl expander. Cone pressure (14 kg/cm2) and production rate (1.1 t/h) were held constant to eliminate the effects of varied cone pressure and throughput on pelleting characteristics of the diet. The conditioned mash was passed through a pellet press (CPM Master Model HD) equipped with a 32-mm thick die having 4 mm openings. Cone temperature (cubic effect, P<0.02) and kWh/t (quadratic effect, P<0.03) increased as water addition into the mixer was increased from none to 12%. Pellet durability index (tumbling box technique) and modified pellet durability index (five hexagonal nuts added into the tumbling box) increased (linear effects, P<0.003) as water addition into the mixer was increased from none to 12%. Means for the none, 1.5, 3, 6, and 12 % additions of water into the mixer were 93, 93, 94, 94 and 95% for pellet durability index and 91, 92, 93, 93 and 94% for modified pellet durability index. In conclusion, expanding barley-oats-soy-based diets resulted in greater pellet durability index although the high durability index for the control diet (93%) left little room for improvement in pellet quality when water was added into the mixer.

Key Words: Pellet, Expander-Conditioning, Pig

T188 Optimal true digestible Ca:P ratio in corn-rough rice-soybean meal-based diets for growing pigs. S. X. Wang*[1], Y. L. Yin[1], R. L. Huang[1], T. J. Li[1], X. F. Kong[1], M. Z. Fan[2], and G. Y. Wu[1,3], [1]*Institute of Subtropical Agriculture, the Chinese Academy of Sciences*, *Changsha, Hunan, China*, [2]*University of Guelph*, *Guelph, Ontario, Canada*, [3]*Texas A&M University*, *College Station*.

Three experiments were conducted to determine an optimal ratio of true digestible Ca:P in diets for barrows. In Experiment 1, 12 barrows (BW 30.6±1.2 kg) were assigned randomly to be fed two corn-rough rice-soybean meal-based diets containing either 0.32% true digestible P and 0.60% total Ca or 70% of their values for 8 d (6 pigs/diet). Endogenous outputs of Ca and P in feces were 0.85 and 0.57 g/kg DM intake, and the true digestibilities of dietary Ca and P were 78 and 66%, respectively. In Experiment 2, 25 barrows with BW of 32.2±1.8 kg were used to determine Ca and P balances. The diets were formulated to contain 0.32% true digestible P as in Experiment 1, except that the amounts of limestone were adjusted to obtain 5 levels of total Ca: 0.29, 0.45, 0.60, 0.75 and 0.90% (n = 5 pigs/diet). Pigs were fed their diets for 8 d. Based on the true digestibilities of dietary Ca and P in Experiment 1, the ratio of true digestible Ca and P in the five diets were 0.89, 1.37, 1.82, 2.29, and 2.75, respectively. The apparent digestibilities of Ca and P were reduced (P<0.05) with increasing dietary Ca:P ratios. Pigs fed a diet with a Ca:P ratio of 1.82 retained more Ca and P than pigs fed diets with higher Ca:P ratios (P<0.05). In Experiment 3 (a 35-d feeding trial) involving 25 barrows with initial BW of 20.9±0.95 kg, pigs were fed the diets as described in Experiment 2. Barrows fed diets with a true digestible Ca:P ratio of 1.82 exhibited higher (P<0.05) values for feed intake, ADG, and the gain:feed ratio, compared with pigs fed diets with true digestible Ca:P ratios of 2.29 and 2.75. These results suggest that a true digestible Ca:P ratio of 1.82 is optimal for P utilization and growth performance of barrows fed corn-rough rice-soybean meal-based diets.

Key Words: Calcium, Phosphorus, Piglets

T189 Effects of adding water into the mixer on pellet quality of expander-processed corn-soy-based diets for finishing pigs. K. K. Lundblad*[1,2], J. D. Hancock[2], M. Sørensen[3,4], K. C. Behnke[2], E. Prestløkken[1], and L. J. McKinney[2], [1]*Felleskjøpet Fôrutvikling*, *Trondheim, Norway*, [2]*Kansas State University*, *Manhattan*, [3]*University of Life Sciences*, *Aas, Norway*, [4]*AKVAFORSK*, *Aas, Norway*.

A corn-soy-based formula was used to determine the effects of adding water into the mixer on pellet quality of expander-processed diets for finishing pigs. The corn (76% of the diet) was ground to a mean particle size of 600 um and blended with soybean meal (17% of the diet), choice white grease (5% of the diet), crystalline amino acids, vitamins, and minerals creating a diet with 0.8% total lysine and 11% total moisture. Treatments were none, 1.5, and 3% water added into the mixer after a 'dry-mix' time of 60 sec. Total mix time was 240 sec. The mixed mash was steam conditioned at 82°C for approximately 20 sec prior to passing through a 100 hp Amandus-Kahl expander. Cone pressure (14 kg/cm2) and production rate (1.1 t/h) were held constant to eliminate the effects of varied cone pressure and throughput on pelleting characteristics of the diet. The conditioned mash was passed through a pellet press (CPM Master Model HD) equipped with a 32-mm thick die having 4 mm openings. Cone temperature was increased by 17% (linear effect, P<0.03) and kWh/t was increased by 36% (quadratic effect, P<0.03) as water addition into the mixer was increased from none to 3%. There was a trend for fines generated during pelleting to be reduced (P<0.07) but pellet durability index (tumbling box technique, P>0.4) and modified pellet durability index (five hexagonal nuts added into the tumbling box, P>0.2) were not affected by water addition into the mixer. Means for the none, 1.5%, and 3.0% additions of water into the mixer were 4.5, 4.0, and 3.7% for fines, 92, 93, and 94% for pellet durability index, and 90, 91, and 92% for modified pellet durability index. In conclusion, expanding corn-soy-based diets resulted in a pellet durability index of 92% for our control diet leaving little room for improvement in pellet quality when water was added into the mixer.

Key Words: Pellet, Expander-Conditioning, Pig

T190 Effects of fermented wild-ginseng culture by-products on growth performance, blood characteristics, meat quality and ginsenoside concentration of meat in finishing pigs. H. D. Jang*[1], J. H. Cho[1], Y. J. Chen[1], J. S. Yoo[1], J. J. Lee[2], M. H. Han[2], and I. H. Kim[1], [1]*Dankook University*, *Cheonan, Choognam, Korea*, [2]*Chungnam Regional Innovation Agency*, *Cheonan, Korea*.

This study was conducted to evaluate effects of fermented wild-ginseng culture by-product on growth performance, blood characteristics, meat quality and ginsenoside concentration of meat in finishing pigs. Forty-eight pigs (Landrace × Yorkshire × Duroc, 76.26±1.06kg average initial body weight) were used in 49d growth assay. Dietary treatments were included 1)CON(basal diet), 2)FWG1(basal diet + 2.5% fermented wild-ginseng cultures by-product replaced lupin in basal diet) and 3)FWG2(basal diet + 5.0% fermented wild-ginseng cultures by-product replaced lupin in basal diet). The pigs were allotted into three treatments with four replicate pens per treatment by completely randomized design. No differences were found among treatments for ADG, ADFI and gain/feed from 0day to 49day of the experiment(P >0.05). Dry matter digestibility was greater in FWG1 treatment than CON treatment (P<0.05). In cholesterol concentration of blood, HDL cholesterol was significantly higher in CON treatment than FWG1 treatment (P<0.05). In meat quality, TBARS was significantly lower in FWG1 and FWG2 treatments than CON treatment (P<0.05). In sensory evaluation, marbling was significantly higher in CON treatment than FWG1 treatment (P<0.05). Firmness in FWG2 and CON treatments were higher than FWG1 treatment (P<0.05). In meat color, L*-value of m. longissmus dorsi muscle was increased in FWG1 treatment compared to CON and FWG2 treatments (P<0.05). a* and b*-value of m. longissmus dorsi muscle were increased in CON and FWG1 treatments compared to FWG2 treatment(P<0.05). Ginsenoside concentration of meat was significantly higher in FWG2 treatment than CON treatment (P<0.05). In conclusion, fermented wild-ginseng culture by-product was effective for improving dry matter, TBARS, firmness, meat color and ginsenoside concentration of meat in finishing pigs.

Key Words: Fermented Wild-Ginseng Cultures By-product, Meat Quality, Pigs

T191 Effect of dietary *Bacillus subtilis* on growth performance, immunological cells change, fecal NH3-N concentration and carcass meat quality characteristics in finishing pigs. J. H. Cho*[1], Y. J. Chen[1], B. J. Min[1], H. J. Kim[1], K. S. Shon[1], O. S. Kwon[1], J. D. Kim[2], and I. H. Kim[1], [1]*Dankook University*, *Cheonan, Chungnam, Korea*, [2]*CJ Feed Co. Ltd.*, *Incheon, Korea*.

This experiment was conducted to investigate the effects of dietary Bacillus subtilis on growth performance, nutrient digestibility, immunological cells change, fecal noxious gas and carcass meat quality characteristics in finishing pigs. The dietary treatments were: 1) CON (basal diet), 2) BS0.1(basal diet + 0.1% Bacillus subtilis) and 3) BS0.2(basal diet + 0.2% Bacillus subtilis). Sixty crossbred (Landrace × Yorkshire × Duroc) pigs (89.5±0.11kg average initial body weight) were used in a 42 days growth trial. The pigs were assigned to the treatments according to body weight and each treatment had 5 replicates of 4 pigs per pen in a randomized complete block design. Through the entire experimental period, ADG and ADFI were not significantly different among the treatments. Pigs fed BS0.1 diet significantly increased their gain/feed compared to pigs fed CON and BS0.2 diets($P<0.05$). Also, dry matter(DM) and nitrogen(N) digestibilities were greater in the pigs fed BS0.1 diet than those fed CON diet($P<0.05$). There were no significant differences in fecal NH3-N concentration among the treatments. In blood assay for immunological cells change investigations, red blood cells (RBC) counts increased in the pigs fed BS0.2 diet compared to pigs fed CON and BS0.1 diets. There were no significant differences in carcass pH, drip loss, marbling and firmness. However, sensual color and a*(redness) value of meat in the pigs fed BS0.2 diet were higher than in pigs fed CON diet($P<0.05$). Therefore, this experiment suggested that Bacillus subtilis supplementation could improve nutrient digestibility, RBC counts and carcass meat color of pigs.

Key Words: Bacillus Subtilis, Carcass Meat Quality Characteristics, Pigs

T192 Evaluation of dietary L-carnitine or garlic powder on growth performance, dry matter and nitrogen digestibilities, blood profiles and meat quality in finishing pigs. Y. J. Chen*[1], J. H. Cho[1], I. H. Hwang[2], Y. Hyun[2], T. G. Go[2], and I. H. Kim[1], [1]*Dankook University*, *Cheonan, Choognam, Korea*, [2]*Easy Bio System Inc*, *Cheonan, Choognam, Korea*.

The effects of dietary L-carnitine or garlic powder supplementation on growth performance, dry matter (DM) and nitrogen (N) digestibilities, blood profiles and meat quality were investigated in this study. A total of 80 [(Landrace×Yorkshire)×Duroc] pigs with an initial BW of 59.14 kg were randomly assigned to four dietary treatments with five replications per treatment and four pigs per pen. Corn-soybean meal based diets were formulated as control diet and other treatment diets were supplemented with 250 mg/kg L-carnitine, and 1 g/kg or 2 g/kg garlic powder, respectively. After the feeding period, pigs which reached marketing body weight were collected meat samples from slaughter house. During the feeding period, growth performance was not affected by dietary treatments. Both the DM and N digestibilities were improved in 1 g/kg garlic powder supplemented treatment compared to control treatment (P<0.05). White blood cell (WBC) and lymphocyte concentrations were positive influenced by L-carnitine addition whereas garlic powder supplementation did not affect any tested parameter of blood profiles. Backfat thickness was decreased and muscle percentage was increased by the L-carnitine supplementation (P<0.05). Pigs administrated with 1 g/kg garlic powder also tended to decrease backfat thickness and had better meat color, pH value and water holding capacity. In conclusion, dietary supplementation of L-carnitine can increase WBC and lymphocyte concentrations and decrease backfat thickness while garlic powder supplementation can improve the nutrients digestibility and meat quality in finishing pigs.

Key Words: L-carnitine, Garlic Powder, Finishing Pigs

T193 Effects of dietary *Lactobacillus brevis* supplementation on growth performance, dry matter and nitrogen digestibilities, blood cell counts and fecal odor emission compounds in growing pigs. Y. J. Chen*[1], B. J. Min[1], J. H. Cho[1], Q. Wang[1], J. S. Yoo[1], J. D. Kim[2], and I. H. Kim[1], [1]*Dankook University*, *Cheonan, Choognam, Korea*, [2]*CJ Feed Inc*, *Incheon, Gyeonggi, Korea*.

This study was conducted to investigate the effects of dietary *Lactobacillus brevis* (3.4×10^8 CFU/g) supplementation on growth performance, DM and N digestibilities, blood cell counts and fecal odor emission compounds in growing pigs. Ninety six crossbred [(Landrace×Yorkshire)×Duroc] pigs with an initial BW of 24.60 ± 1.28 kg were used for 42-d feeding trial according to a randomized complete block design. Three corn-soybean meal based dietary treatments included: 1) CON (basal diet); 2) LB1 (basal diet + *Lactobacillus brevis* 0.2%) and 3) LB2 (basal diet+ *Lactobacillus brevis* 0.4%). There were three dietary treatments with eight replicate pens per treatment and four pigs per pen. Through the entire experimental period, ADG, ADFI and gain/feed were not significantly different among the treatments (P>0.05). Nitrogen digestibility was increased in LB1 and LB2 treatments compared to CON treatment (linear effect, P<0.05), however, DM digestibility was not significantly different among all the treatments (P>0.05). The WBC, RBC and lymphocyte concentrations in whole blood were not affected by treatments (P>0.05). Fecal NH_3-N and H_2S concentrations were significant decreased in LB2 treatment compared with CON treatment (linear effect, P<0.05). Fecal VFA (acetic acid and propionic acid) concentration was also reduced in LB2 treatment compared to CON treatment (linear effect, P<0.05). In conclusion, *Lactobacillus brevis* (3.4×10^8 CFU/g) supplementation at the level of 0.4% can improve nitrogen digestibility and decrease the concentrations of fecal odor emission compounds in growing pigs.

Key Words: *Lactobacillus Brevis*, Odor Emission Compounds, Growing Pigs

T194 Effects of feeding rye silage with different periods on growth performance, blood characteristics and carcass quality in finishing pigs. S. O. Shin*[1], J. H. Cho[1], Y. J. Chen[1], J. S. Yoo[1], J. W. Kim[1], Y. G. Han[2], and I. H. Kim[1], [1]*Dankook University*, *Cheonan, Choongnam, Korea*, [2]*Sungkyunkwan University*, *Suwon, Gyeonggi, Korea*.

This experiment was conducted to evaluate effects of feeding rye silage with different periods on growth performance, blood characteristics and carcass quality in finishing pigs. A total of sixteen [(Duroc×Yorkshire×Landrace)] pigs (90.26kg in average initial body weight) were used in individual cage for 30 days assay. Dietary treatments included 1) CON (basal diet), 2) S10 (basal diet for 20 days and 3% rye silage for 10 days) 3) S20 (basal diet for 10 days and 3% rye silage for 20 days) 4) S30 (3% rye silage for 30 days). During the overall periods, there were no significant differences in ADG and gain/feed ratio among treatments (P>0.05). However, ADFI was higher in CON treatment than others treatments (P<0.05). DM digestibility was higher in S20 treatment than S30 treatment (P<0.05). In blood characteristics, pigs fed rye silage were significantly decreased cortisol concentration compared with pigs fed CON diet (P<0.05). Backfat thickness was higher in CON treatment than S20 and S30 treatments (P<0.05). In fatty acid contents of leans, C18:0 and total SFA were significantly higher in CON treatment than others treatments (P<0.05). However, C18:1n9, total MUFA and U:S ratio were significantly lower in CON treatment than other treatments (P<0.05). In fatty acid contents of fats, C18:1n9 and MUFA were similar in S20 and S30 treatments. However, these were higher than CON or S10 treatments (P<0.05). In conclusion, feed intake, DM digestibility, cortisol concentration, backfat thickness and fatty acid composition of pork were affected by 20 d of rye silage feeding.

Key Words: Rye Silage, Carcass Characteristics, Finishing Pigs

T195 Effects of phytogenic substances on growth performance, nutrients digestibility, fecal noxious gas content, blood characteristics, milk characteristics and reproduction in sows and litters performance. Q. Wang*, H. J. Kim, J. H. Cho, Y. J. Chen, J. S. Yoo, and I. H. Kim, *Dankook University*, *Cheonan, Choognam, Korea*.

A total of forty sows (Landrace×Yorkshire) were used to determine the effects of phytogenic feed additive (PFA) on growth performance, nutrients digestibility, fecal noxious gas content, blood characteristics, milk characteristics and litters performance. Dietary treatments included: 1) Control (CON; basal diet), 2) PFA (basal diet + 0.04% phytogenic feed additive). Through the entire experimental period,

ADFI, backfat loss and return-to-estrus intervals were not affected by the treatments ($P>0.05$). Digestibility of DM was increased ($P<0.05$) in sows fed PFA diet compared with sows fed the CON diet. Fecal ammonia nitrogen (NH_3-N) measured at the end of experiment was reduced ($P<0.05$) in sows fed PFA diet. No statistical differences ($P>0.05$) were found in total protein, albumin, immunoglobulin G (IgG), red blood cells (RBC) counts, white blood cells (WBC) counts and lymphocyte on the day of farrowing. On d 1 of lactation, albumin and lymphocyte were decreased ($P<0.05$) whereas WBC was increased significantly ($P<0.05$) for sows fed the PFA diet. On d 21 of lactation, blood characteristics (RBC and WBC) of sows were increased ($P>0.05$) in PFA treatment. IgG content in milk was increased by PFA on day of farrowing ($P<0.05$). Milk protein and solid concentrations were lower in colostrum ($P<0.05$) for sows fed the CON diet. Furthermore, lactose, IgG and IgA in colostrum increased considerably for sows fed PFA diet. There was no difference in piglet performance between treatments ($P>0.05$). In conclusion, feeding 0.04% of PFA improved DM digestibility, RBC and WBC concentrations in blood, and lactose, IgG and IgA production in colostrums and decreased noxious gas concentration.

Key Words: Phytogenic Additives, Sows, Litters

T196 Effects of supplemental humic substances on quality and fatty acid profile of meat in finishing pigs. Q. Wang*, J. H. Cho, Y. J. Chen, J. S. Yoo, and I. H. Kim, *Dankook University*, *Cheonan, Choognam, Korea*.

A total of forty-eight finishing pigs were used to determine the effects of humic substances (HS) on growth performance, blood characteristics and meat quality. Finishing pigs were randomly assigned by weight to three treatments. Dietary treatments included: 1) Control (CON; basal diet), 2) HS1 (basal diet +5% humic substances) and 3) HS2 (basal diet + 10% humic substances). During the entire experimental period, results showed that addition of 100 g kg^{-1} HS to diet significantly increased ADG and G:F ($P<0.05$). At the end of experiment, lymphocyte of pigs fed HS1 or HS2 diet was higher ($P<0.05$) than that for pigs fed CON diet. The Minolta color parameter a* for pigs fed HS2 was similar to that for pigs fed HS1, however, it was higher ($P<0.05$) than that for pigs fed CON diet. Inclusion of either 5 or 10% HS decreased backfat thickness ($P<0.05$). Marbling score was increased ($P<0.05$) in diets supplemented with HS at level of 10%. In the lean samples, HS1 increased ($P<0.05$) the concentrations of C16:0, C18:0, saturated fatty acid (SFA) and unsaturated fatty acid (USFA) and decreased ($P<0.05$) the concentration of C20:0. HS2 diet increased ($P<0.05$) the U:S ratio. In contrast to fat samples, HS2 diet increased ($P<0.05$) the concentrations of C14:0, C18:2. HS1 diet increased ($P<0.05$) the concentrations of C18:0 and SFA and decreased ($P<0.05$) UFA and U:S ratio. The results suggest that HS could be used as feed additive in diet. It could improve growth performance, immunity system and meat quality.

Key Words: Humic Substance, Meat Quality, Finishing Pigs

T197 Effects of dietary herbs and coral mineral complex on growth performance, nutrients digestibility, blood characteristics and meat quality in finishing pigs. Y. Wang*, J. H. Cho, Y. J. Chen, J. S. Yoo, Q. Wang, and I. H. Kim, *Dankook University*, *Cheonan, Choognam, Korea*.

Eighty crossbred ([Landrace×Yorkshire]×Duroc) pigs (initial BW of 58.06 ± 1.47 kg) were used to evaluate the potential effect of supplemental herbs and coral mineral complex (HC), which including 40% herbs: *Semen Ziziphi Spinosae* (Spina Date Seed) 10%, *Pollen Pini* (Pine Pollen) 5%, *Cortex Mori* (White Mulberry Root-bark) 5%, *Semen Plantaginis* (Plantago asiatica) 5%, *Radix Achyranthis Bidentatae* (Achyranthes root) 5%, *Rhizoma Acori Tatarinowii* (Grassleaf Sweelflag Rhizome) 5% and *Herba Capsellae* (Shepherdspurse Herb) 5%, 50% coral mineral (Ca 22%, P 2%, Mg 3%, Mn 0.5%, Na 2%, Cl 1%, Zn 0.5%, Fe 1.5%, Se 1% and other 16.5%) and 10% cromophore, on growth performance, nutrients digestibility, blood characteristics and meat quality in a 8 wk growth trial in finishing pigs. There are 4 pigs per pen and 5 replicates per treatment. Dietary treatments included: 1) CON (control; basal diet), 2) HC0.05 (basal diet + 0.05% HC), 3) HC0.1 (basal diet + 0.1% HC) and 4) HC0.2 (basal diet + 0.2% HC). Average daily feed intake decreased linearly with increasing HC level during wk 4-8 ($P<0.01$) and overall period ($P<0.05$). However, this decrease did not affect ADG and linearly increased G:F during wk 4-8 ($P<0.05$) and overall period ($P<0.10$). Digestibility of DM and N were not affected by dietary treatments ($P>0.05$). Also, IgG concentration was linearly increased with an increasing HC level ($P<0.01$). Cortisol concentration tended ($P<0.10$) to be influenced linearly by level of HC. Supplementation of HC did not improve any measured meat quality ($P>0.05$). Our data indicate that HC inclusion can increase the G:F, as well as IgG and cortisol concentration, however, it had no effects on nutrients digestibility and meat quality.

Key Words: Herb, Coral Mineral, Finishing Pigs

T198 Effects of dietary supplemental Megazone® on growth performance, nutrients digestibility, blood characteristics, meat quality and carcass traits in weaning-to-finishing pigs. Y. H. Kim[1], Y. Wang*[2], J. C. Park[1], H. J. Jung[1], J. H. Cho[2], Y. J. Chen[2], J. S Yoo[2], I. C. Kim[1], S. J. Kim[1], and I. H. Kim[2], [1]*National Livestock Research Institute, RDA*, *Cheonan, Choognam, Korea*, [2]*Dankook University*, *Cheonan, Choognam, Korea*.

This study was conducted to investigate the effects of Megazone® (an alumninosilicate mineral mix, which include 30% quartz, 30% feldspar, 30% ceramic and 10% biotite) supplementation on growth performance, nutrients digestibility, blood characteristics, meat quality and carcass traits in weaning-to-finishing pigs. A total of 48 crossbred ([Landrace×Yorkshire]×Duroc) pigs with initial BW of 4.46 ± 0.18 kg were used in a 21 wks trial. Pigs were randomized allocated to two dietary treatments. There were 6 pens per treatment and 4 pigs per pen. Dietary treatments included: 1) CON (basal diet) and 2) MT (basal diet + 0.8% Megazone®). Through the entire experimental period, there were no effects of dietary Megazone® supplementation on growth performance, nutrients digestibility, blood characteristics and meat quality ($P>0.05$). Also, market weight and backfat thickness were

not different between the two treatments (P>0.05). However, carcass weight and carcass ratio in MT treatment were improved compared with CON treatment (P<0.05). In conclusion, supplementation of Megazone® can increase carcass weight and carcass ratio in weaning-to-finishing pigs, however, it had no effects on growth performance, nutrients digestibility, blood characteristics and meat quality traits.

Key Words: Megazone®, Alumninosilicate, Carcass

T199 Interaction of dietary nutrient density and crowd density on growth performance, nutrients digestibility, blood characteristics and hormone concentration in growing pigs. Y. Wang*, J. H. Cho, Y. J. Chen, H. J. Kim, J. S. Yoo, Q. Wang, Y. Huang, and I.H. Kim, *Dankook University*, *Cheonan, Choognam, Korea*.

A study was conducted to determine the interaction of feeding a high nutrient diet (3,350Mcal/kg, Crude protein 19%, Lysine 1%, Ca 0.8%, P 0.7%) vs. a low nutrient diet (3,350Mcal/kg, Crude protein 18%, Lysine 0.9%, Ca 0.7%, P 0.6%), as well as the crowd density (3, 4 or 5 pigs per pen), on growth performance, nutrients digestibility and blood characteristics. Ninety six crossbred ([Landrace×Yorkshire]×Duroc) pigs (initial BW of 23.47±1.35 kg) were assigned to a 2×3 factorial arrangement of treatments. Growth data were collected at d 0, d 18 and d 36. Overall the experiment, nutrient density main effect were observed on ADG, ADFI and G/F (P<0.05). Also crowd density main effect and nutrient density×crowd density interaction were observed on G/F. Both the DM and N digestibility were higher in the high nutrient diet treatment compared with low nutrient diet treatment (P<0.05). Neither the dietary nutrient density nor crowd density main effects were found on blood characteristics (P>0.10) in this experiment. Epinephrine and norepinephrine concentrations were higher (P<0.05) in high nutrient diet treatment compared with low nutrient diet treatment. Neither the dietary nutrient density nor crowd density main effects were found on cortisol concentration (P>0.05). Our data indicate that significant interaction between nutrient density and crowd density treatments for G/F. ADG and ADFI, as well as epinephrine and norepinephrine concentration have significant nutrient density main effect. Neither the dietary nutrient density nor crowd density effects were found on blood characteristics as well as cortisol concentration in this experiment.

Key Words: Crowd Density, Nutrients Density, Growing Pigs

T200 The effects of environment-friendly diets on the growth performance, nutrient digestibility, fecal excretion, nitrogen excretion and emission gas in swine manure of growing pigs. J. S. Yoo*[1], J. H. Cho[1], Y. G. Chen[1], H. J. Kim[1], Q. Wang[1], Y. Hyun[2], T. G. Ko[2], C. S. Park[3], and I. H. Kim[1], [1]*Dankook University*, *Cheonan, Choognam, Korea*, [2]*Dodram B&F Inc.*, *Eumseong, Gyeonggi, Korea*, [3]*EASY BIO System, Inc*, *Seoul, Korea*.

Two experiments were conducted to determine the effects of environment-friendly diets on growth performance, fecal excretion, N excretion and emission of gas in manure for pigs. In Exp. 1, 96 cross-bred pigs were allocated into four treatments. Treatments were 1)AME(adequate ME diet, 3,265 kcal/kg), 2)LME (lower ME diet, 3,100 Kcal/kg), 3)LME 0.05(lower ME diet+α-galactosidase & β-mannanase0.05 %) and 4)LME 0.1(lower ME diet+α-galactosidase & β-mannanase0.10 %). ANE had lower ADFI than others(P<0.05). DM digestibility in AME and LME 0.1 had greater than LME(P<0.05). Energy digestibility is higher in pigs fed AME and LME 0.1 than others(P<0.05). In Exp. 2, 24 crossbred pigs(Avg. 33.71 kg) were used for a 14d trial. Treatments were 1)CP 18% without *Bacillus* sp., 2)CP 18%diet+*Bacillus* sp.0.05%, 3)CP 14% without *Bacillus* sp. and 4)CP 14% diet+ *Bacillus* sp.0.05%. N intake was higher for CP 18% diets than CP 14% diets (P<0.05). DM, N, and energy digestibility were affected by probiotics (P<0.05). With the high CP in diets, energy and N digestibility, urinary N %, urinary N excretion and total N excretion were increased compared with low CP in diets (P<0.05). Among the treatments, DM and N digestibilities, fecal N excretion and N absorption were decreased (P< 0.05), however, fecal excretion, fecal N, urinary N percent, urinary N excretion and total N excretion were increased (P<0.05) when pigs fed without probiotics diets compare with pigs fed with probiotics diets. DM and N digestibility, fecal excretion, fecal N excretion, urinary N percent, urinary N excretion, total N excretion, N absorption and N adsorption ratio were CP × probiotic interactions in (P<0.05). Ammonia(P<0.01) and H2S(P<0.05) in manure were lower in CP 14% diets than CP 18% diets. Also, ammonia and H_2S in manure were CP × probiotic interactions in (P<0.05). In conclusion, low energy and reduction of CP dietary added enzyme and probiotics improved nutrient digestibility and reduced odors emission in manure for growing pigs.

Key Words: Environment-Friendly Diets, Carbohydrase, Probiotics

T201 Growth performance in boars fed diets supplemented with organic selenium. S. M. Speight*, M. J. Estienne, and A. F. Harper, *Virginia Polytechnic Institute and State University*, *Blacksburg*.

The objective was to compare growth performance in boars fed diets supplemented with selenium from either organic or inorganic sources. Crossbred boars (n = 117; 8.3 kg BW) weaned at approximately 28 d of age, were blocked by BW, placed in nursery pens (three boars/pen) and assigned from within block to three treatments: I. a basal diet with no supplemental selenium (controls), II. basal diet supplemented with 0.3 ppm organic selenium (Sel-Plex; Alltech, Inc., Nicholasville, KY) and, III. basal diet supplemented with 0.3 ppm sodium selenite (Premium Selenium 270; North American Nutrition Co., Inc., Lewisburg, OH) (n = 13 pens/treatment). Boars had ad libitum access to feed and water during the 5-wk trial. Among groups, ADG (471 g), ADFI (895 g) and feed/gain (1.9) were similar (P > 0.1). Blood selenium concentrations (ppb) were higher (P < 0.01) for boars consuming Sel-Plex (107.5 ± 4.8) or sodium selenite (114.7 ± 4.8) compared to controls (28.4 ± 4.8). Boars were moved to a grower-finisher barn and continued to receive, on an ad libitum basis, either a basal diet or a basal diet supplemented with either 0.3 ppm Sel-Plex or sodium selenite (n = 11 pens/treatment). The trial ended when boars averaged 136.7 kg. Among groups, ADG (1045 g) and ADFI (2716 g) were similar (P > 0.1). Feed/gain was affected by treatment (P = 0.02) and was lower (P < 0.06) for boars fed Sel-Plex (2.65 ± 0.03) compared with boars fed sodium selenite (2.72 ± 0.03) or controls (2.76 ± 0.03). Backfat thickness (tenth-rib; 12.6 mm) and loin depth (67.0 mm), determined by ultrasound (Sonograder; Renco Corp., Minneapolis, MN), was not affected by treatment (P > 0.1). Blood selenium concentrations (ppb) were higher (P < 0.01) in boars consuming Sel-Plex (198.9 ± 5.5) than in boars consuming sodium selenite (171.4 ± 5.4) or controls (26.7 ± 5.4). In summary, an organic

source of selenium failed to alter ADG or feed consumption in growing boars, but enhanced feed conversion efficiency during the grower-finisher phase of production. (Funded by Alltech, Inc.)

Key Words: Boars, Selenium, Growth

T202 A polymorphism in the calcitonin receptor alters metabolic response to dietary phosphorus deficiency. L. S. Alexander*, S. A. Cutler, M. F. Rothschild, and C. H. Stahl, *Iowa State University*, *Ames*.

While much research has examined methods for reducing the need for dietary phosphate (P) supplementation, little has examined how genetics may affect this need. We have identified a polymorphism in the calcitonin receptor gene, which based on previous work in our laboratory, influences the response to dietary P deficiency. Gilts (42, 8.1+ 2 kg BW) were selected based on this genotype and fed either a P adequate diet or a 20% P deficient diet over a 15 wk period. Each of the genotypes (11, 12, and 22) was evenly distributed across diets. At the end of the trial, radial and metacarpal bones from one leg per pig were collected for bone strength analysis and determination of ash %. Data was analyzed using the GLM procedure of SAS with diet, genotype and genotype*diet treated as fixed effects. Initial BW and final BW were used as covariates for growth performance and bone strength, respectively. Our diets caused a minor P deficiency detectable by reduced (P<0.05) plasma P by 8wk, which remained throughout the study. At 8wk, a significant (P <0.01) genotype*diet effect was seen in plasma levels of 1,25 $(OH)_2D_3$; however, by 14wk only a diet effect remained with the P deficient animals having higher (P<0.05) levels in plasma. Dietary P deficiency lowered bone strength (load at yield and Young's modulus) and ash % (P<0.05), and there tended (P<0.1) to be genotype*diet interactions in these measures in the metacarpals. It appears that during P adequacy, the 11 and 12 genotypes tended to have stronger bones with higher ash % than their 22 counterparts. However under dietary P deficiency, the 11 and 12 genotypes had much greater losses (P<0.05) in all of these bone measures than the 22 pigs. There were no differences in growth performance based on diet, genotype, or the interaction of the two, suggesting that minor P deficiency still has a significant impact on bone integrity, and that this genotype is associated with pigs' response to P deficiency.

Key Words: Phosphorus, Polymorphism, Pig

T203 Evaluation of different additives in weaned pigs. K. J. Touchette*, M. D. Newcomb, and D. W. Giesting, *Cargill Animal Nutrition*, *Elk River, MN*.

A trial was conducted with 48 weaned pigs (17 d, 5.41 ± .11 kg) to evaluate the effect of non-antibiotic additives alone or in combination with antibiotics on nursery performance. Pigs were weaned and individually housed and assigned to one of 4 treatments in a 2x2 factorial arrangement in a RCBD with 2 levels of antibiotics (AB, none or added) and 2 levels of additives (ADD, none or added). The antibiotic used in this study was carbadox fed at 55 mg/kg. A nonspecific stressor was used in this trial. Twelve late nursery pigs that had been reared in an on-site, continuous pig flow environment were housed with nose-to-nose access with test pigs used in this project. Previous work has shown that this stressor application dramatically increases the responsiveness to antibiotic inclusion. The additives used in this study were a combination of enzymes, sweetener, and a *Bacillus* DFM. Pigs were fed a 3-phase 40 d nursery program with diet changes on days 11 and 20. In the first 11 d, both AB (p< .06) and ADD (p< .12) improved ADG. There was an interaction (p< .07) for ADFI, with ADD improving ADFI when AB were in the diet, but no improvement was seen without AB. Feeding AB improved (p < .13) G/F. For phase 2, ADD (p < .11) improved ADG, AB (P < .16) improved ADFI, while there was an interaction (p < .05) for G/F, with ADD improving G/F without AB in the diet, and having no effect on G/F with AB in the diet. For phase 3, there was no effect of trt on feed intake, while there were interactions for both ADG (p < .12) and G/F (p < .01). ADD improved both ADG and G/F in diets without AB, while having no effect in diets with AB. For the entire 40 d nursery trial, both ADD (p < .05) and AB (p < .03) improved ADG, and AB (p < .11) improved ADFI, while there was an interaction (p < .01) for G/F. ADD improved G/F without AB in the diet, while ADD did not affect G/F with AB in the diet. This study demonstrates that this additive mixture and carbadox improve nursery performance, with the best response to ADD coming in diets without AB.

Key Words: Swine, Antibiotics, Additives

T204 Effect of an *Escherichia coli*-derived phytase on bone mineralization, and total and soluble phosphorus in growing pigs fed corn-soybean meal based diets. C. T. Kadzere*[1,4], E. van Heugten[1], J. S. Sands[2], R. Maguire[1,3], and M. Morrow[1], [1]*North Carolina State University*, *Raleigh*, [2]*Danisco Animal Nutrition*, *Marlborough, UK*, [3]*Virginia Polytechnic and State University*, *Blacksburg*, [4]*PDT Global Institute, Inc.*, *Greensboro, NC*.

The effect of an *Escherichia coli*-derived phytase (Phyzyme XP™ 5000L) on bone mineralization, soluble phosphorus P (SP), and total phosphorus P (TP) in feces was evaluated in a 43-d, RCBD study using 30 male, castrated growing pigs (starting BW = 25 kg) fed corn-soybean meal based diets. Pigs were placed in individual pens and assigned to 5 groups of 6 animals each and fed one of 5 diets. A positive control diet (PC) contained NRC (1998) recommended levels of 0.49% TP and 0.52% Ca. TP and Ca in the negative control (NC) diet were reduced to 0.36% and 0.43%, respectively. Diets 250, 500, and 1000 were the same as NC with phytase included at 250, 500, and 1000 U/kg phytase, respectively. Pigs were weighed weekly and had free access to feed and clean water. On d-21 and d-43 fecal grab samples were collected and analyzed for SP, and TP was analyzed in pooled samples collected on d 36, 37, and 38. Pigs were slaughtered on d 43, the right foot removed, and the metacarpal bone taken and analyzed for bone ash. In addition, bone mineral content (BMC), and bone mineral density (BMD) were determined using dual X-ray absorptiometry. Fecal TP (P < 0.0001) and SP (P < 0.0001) decreased linearly with increasing phytase dose. Bone ash increased linearly with increase in phytase dose to 1000 FTU/kg, while only 500 FTU/kg phytase was required to restore bone ash to that of the PC diet. In contrast, the response in BMC and BMD was quadratic in nature with no further improvement above additions of 250 FTU/kg. The results suggest phytase allows dietary Ca and TP in swine diets to be reduced without compromising bone mineralization while decreasing SP and TP excretion.

Key Words: Phosphorus, Phytase, Bone Mineralization

T205 Synthetic lysine inclusion rates in pigs from 1.5 to 5.5 kg fed liquid diets. A. E. Ikard*[1], R. J. Harrell[2], J. Odle[1], L. R. Gast[1], and J. H. Eisemann[1], [1]*North Carolina State University*, *Raleigh*, [2]*Novus International Inc.*, *St. Louis, MO*.

This experiment was designed to determine the amount of synthetic lysine (SL) that could replace protein and maintain performance similar to animals on a control diet containing no SL. Pigs (1.62 ± 0.20 kg BW; age 1d) were randomly allotted to treatments which replaced 0 to 40% of lysine from protein with SL, while maintaining similar amounts of GE and total lysine. The diets were fed on a restricted (RT) basis (n=4/treatment) in order to reduce intake differences among treatments. An additional group was fed the 0% SL diet ad libitum (AL; n=5) to determine feed intake level. Intake for RT pigs was restricted to 80% of AL and adjusted on a daily basis. Pigs fed the AL diet had greater (P<0.01) ADG, G:F, water, CP, fat, and ash accretion than pigs fed RT diets. ADG, G:F, water, CP, and ash accretion decreased (P<0.05) linearly as SL increased in RT diets. CP accretion also showed a quadratic effect (P<0.05) as the accretion decreased more rapidly at greater SL inclusion. Fat accretion increased (P<0.05) linearly as SL increased in RT diets. BUN concentration did not differ (P>0.05) among pigs fed RT diets, but was greater (P<0.01) for pigs fed the AL than RT diets. ADG and CP accretion data were fit to a quadratic equation to estimate the level of SL inclusion that would produce ADG or CP accretion at 95% of the 0% SL diet. These values were 14.8% and 19.0% SL, for ADG and CP accretion, respectively.

Table 1: Effect of SL inclusion (%) on ADG (g/day), G:F, and accretion (g/day)[1,2]

	0%	10%	20%	30%	40%	0% AL
ADG[3]	286	283	268	252	229	363
G:F[3]	1.12	1.14	1.07	0.97	0.86	1.15
Water[3]	180.6	172.8	171.3	155.9	134.2	220.2
CP[3,4]	38.6	38.1	35.4	32.7	26.3	48.7
Fat[3]	16.4	19.6	22.5	25.6	28.4	27.7
Ash[3]	5.4	4.6	4.9	4.5	3.6	6.2

[1]Least square means. [2]RT and AL diets differ for all variables (P<0.01). [3]Linear response to SL level within RT (P<0.01). [4]Quadratic response to SL level within RT (P<0.05).

Key Words: Liquid Diet, Lysine, Pigs

T206 Effect of an *Escherichia coli*-derived phytase on nutrient digestibility in corn-soybean meal based diets for growing pigs. C. T. Kadzere*[1,4], E. van Heugten[1], J. S. Sands[2], R. Maguire[1,3], and M. Morrow[1], [1]*North Carolina State University*, *Raleigh*, [2]*Danisco Animal Nutrition*, *Marlborough, UK*, [3]*Virginia Polytechnic and State University*, *Blacksburg*, [4]*PDT Global Institute, Inc.*, *Greensboro, NC*.

The effect of an *Escherichia coli*-derived phytase (Phyzyme XP™ 5000L) on nutrient digestibility was evaluated in a 43-d, RCBD study using 30 male castrated pigs fed corn-soybean meal based diets. Pigs were placed in individual pens and six animals assigned to each of 5 diets: A positive control diet (PC) with NRC (1998) recommended levels of 0.49% total P (TP) and 0.52% Ca, respectively. Ca and TP in a negative control (NC) diet were reduced to 0.36% and 0.43%, respectively. Diets 250, 500, and 1000 were created by adding phytase to the NC diet to achieve 250, 500, and 1000 U/kg of phytase in feed, respectively. Pigs were weighed weekly and had free access to feed and clean water. Fecal grab samples were collected on 3 consecutive days (d-36, 37, and 38) and pooled. Ileal samples were collected from euthanized pigs on d-43. Feed, fecal, and ileal samples were analyzed for DM, GE, N, Ca, P, Na, K, Cl, amino acids (AA), phytase activity, and acid insoluble ash (indigestible marker). Growth performance was not affected by treatment (P > 0.10). Increasing phytase dose increased the apparent fecal digestibility of P (P < 0.001), fat (P < 0.03) and Cl (P < 0.03). Increasing phytase dose increased the apparent ileal digestibility of P, fat, ash, and Cl in a linear manner to the highest phytase dose of 1000 FTU/kg (P < 0.05). Improvements in ileal DM and CP digestibility with added phytase approached significance (P < 0.07). The apparent ileal digestibility of AA was not different between the NC and PC diets (P > 0.10). However, increasing phytase dose increased digestibility of all AA in a linear manner, being greatest for diets with 1000 FTU/kg phytase and exceeding that of both NC and PC diets. These findings suggest that phytase increases phytate P and trace mineral availability, and has additional benefits, including improved digestibility of DM, CP, fat, and AA.

Key Words: Pigs, Phytase, Nutrient Digestibility

T207 Improving fat utilization by the weanling pig: effects of emulsification, diet physical form and fatty-acid-chain-length on growth performance. K. Price*[1], L. Xi[1], E. van Heugten[1], G. Willis[2], and J. Odle[1], [1]*North Carolina State University*, *Raleigh*, [2]*Milk Specialties Co.*, *Dundee, IL*.

Previous research indicates that dietary fat utilization by the newly-weaned pig is low, while fat digestive capabilities prior to weaning are very high. Sow milk contains approximately 40% fat whereas nursery diets are rarely formulated to contain more than 5%. The aim of this experiment was to determine if emulsification (plus or minus Tween-80), physical form of the diet (liquid vs dry) or fatty acid chain length (medium vs long chain triglyceride) effect fat utilization by the newly weaned pig. Pigs (N= 96) were weaned at 20 ± 0.30 d of age (6.8 ± 0.03 kg) and fed one of eight treatments for 14 d according to a 2x2x2 factorial design. The MCT fat contained primarily C8 and C10 fatty acids while the LCT fat was supplied by choice white grease. Each fat was spray dried with or without the inclusion of Tween-80 emulsifier (at 2% w/w) and comprised 12% of the final diets. Diets were otherwise formulated to exceed NRC nutrient requirements. Liquid diets were reconstituted with water to 13% dry matter and were offered ad libitum via milk-replacer feeders (Kane Manufacturing). Diet physical form greatly accelerated piglet growth (P<0.05), with liquid-fed pigs (488 g/d) out gaining dry-fed pigs (333 g/d) by 47%. Triglyceride chain length also impacted growth (P<0.05), with pigs fed LCT outperforming MCT-fed pigs by 23%. Effects of emulsifier were not detected (P>0.1). Accelerated growth was accompanied by elevated feed intake which was 15 % greater for liquid-fed than for dry-fed pigs and was 22% greater for pigs fed LCT vs MCT. Accordingly, gain:feed was improved by 28% in liquid-fed pigs (P<0.05). Collectively, we infer that feeding liquid diets containing long chain triglycerides will enhance weanling pig growth performance.

Key Words: Weanling Pigs, Milk or Dry Diet, FA Chain Length

T208 Reproductive response of replacement gilts to dietary beta-carotene supplementation. C. A. Mejia-Guadarrama*[1,2], I. Ordoñez-Reyes[2], E. Villagómez-Amezcua[3,2], J. A. Rentería-Flores[1,2], and J. A. Cuarón-Ibargüengoytia[1,2], [1]*CENID-Fisiologíia Animal INIFAP*, *Queretaro, Mexico*, [2]*FESC-Universidad Nacional Autónoma de México*, *Queretaro, Mexico*, [3]*CENID-Microbiología INIFAP*, *D.F., México*.

To determinate the effect of beta-carotene (BC) on the ovulation rate and embryo survival in gilts, a total of 30 LND x DRC gilts were used with an initial weight and age of 130±3.5 kg and 270±0.5 days, respectively. Estrous were synchronized using Regumate in feed for 18 days. Gilts were allotted to two treatments: 1) SBC (BC free) or 2) WBC (BC 255mg/day in feed). Diets were fed starting on day 22 before AI and until day 31 pos-breeding. During the phase previous to AI, gilts received 3 kg/day of a single growing feed (3.2 Mcal ME/kg and 17.5% de CP), containing or not BC (85 mg/kg). Once gilts were inseminated, they were fed 2.2 kg/day of a single gestation feed (3 Mcal ME/kg and 15% CP), containing or not BC (115 mg/kg), until sacrifice. Estrous detection was made twice a day. Gilts were artificially inseminated, and weighed at the beginning of the experiment, after AI, and a day before sacrifice. All gilts were slaughtered at day 31±2, after inseminated, to collect the reproductive tract (ovaries and uterus). Data were analyzed by ANOVA for a completely randomized design. The live body and ovaries weights of gilts were similar (P>0.45) between treatments. Addition of BC to the diet did not modify (P>0.80) the ovulation rate or the ovulation quality (presence of cysts) of the gilts. The potential loss of embryos was lower (P=0.06) in WBC gilts than in SBC gilts (2.2 vs. 3.3 embryos, respectively). When the relative risk of potential loss of embryos was calculated, we found that using BC reduced the loss of embryos 56% compared to SBC. We conclude that BC intake does not alter ovulation rate, but may decrease the risk of embryo losses by 44% compared to gilts not fed BC in diet.

Key Words: Beta-carotene, Embryo Survival, Gilt

T209 The effects of Quantum™ phytase on pig bone ash percentage and performance. A. L. Wagner*[1], A. F. Harper[1], M. J. Estienne[1], M. E. Persia[2], M. R. Bedford[2], and J. Escobar[1], [1]*Virginia Polytechnic Institute and State University*, *Blacksburg*, [2]*Syngenta Animal Nutrition*, *Research Triangle Park, NC*.

Fat-free metacarpal bone ash percentage (FFBAP) is a sensitive measure of the phosphorus (P) adequacy of swine diets. Two experiments were conducted to determine the effects of two doses of Quantum™ phytase (QP) on FFBAP and performance of pigs fed reduced available P (AP) diets. The positive control diet (PC) met or exceeded NRC (1998) recommendations for all nutrients. The negative control diet (NC), which was similar to PC but deficient in AP, was supplemented with 0, 250 or 500 FTU of QP/kg diet. Pigs were fed a common diet until they reached 10 kg BW, after which experimental diets were fed until the unsupplemented NC group reached 20 kg BW. All pigs (Exp. 1) or four pigs per pen (Exp. 2) were killed and the front right foot was collected for FFBAP analysis. Data were analyzed using ANOVA and means separated using specific pre-planned contrasts. In Exp.1, 24 pigs per treatment (3 pigs per pen of mixed sex) were used. A reduction ($P < 0.01$) in FFBAP (5.5% units), ADFI (119 g), and ADG (155 g) was measured in pigs fed unsupplemented NC compared to PC. Addition of QP to NC increased FFBAP (2.2 and 2.6% units, $P < 0.003$), ADFI (76 and 81 g, $P < 0.06$) and ADG (63 and 49 g, $P < 0.04$) for the 250 and 500 FTU/kg diets, respectively. In Exp. 2, 120 pigs per treatment (12 pigs per pen, split sex with 5 pens of barrows and 5 of gilts per treatment) were used. A reduction ($P < 0.0001$) in FFBAP (5.6% units), ADFI (159 g), and ADG (141 g) was measured in pigs fed unsupplemented NC compared to PC. Addition of QP to NC increased FFBAP (1.8 and 2.8% units, $P < 0.003$), ADFI (18 g, $P = 0.19$ and 23 g, $P = 0.07$) and ADG (18 g, $P = 0.17$ and 50 g $P = 0.004$) for the 250 and 500 FTU/kg diets, respectively. These data demonstrate the ability of QP to increase bioavailability of phytate P and consistently increase pig FFBAP, as well as to increase ADFI and ADG in pigs fed AP deficient diets.

Key Words: Pig, Phytase, Bone Ash

T210 Effect of substitution of sorghum by corn on performance of growing/finishing barrows and gilts. H. Bernal-Barragán*[1], E. Castellanos-Martínez[2], E. M. Romero-Treviño[2], E. Gutiérrez-Ornelas[1], M. A. Cerrillo-Soto[3], A. S. Juárez-Reyes[3], H. Morales-Treviño[1], and J. Colín-Negrete[1], [1]*Fac. de Agronomía UANL*, *Marín N.L., México*, [2]*Instituto Tecnológico de Altamira*, *Altamira, Tamaulipas*, [3]*Fac. de Medicina Veterinaria y Zootecnia UJED*, *Durango, Dgo, México*.

One 35-d trial was conducted to determine the effects of four type of grain mixtures (sorghum or corn) on productive performance of growing pigs. A total of twenty-four crossbred (Landrace × Yorkshire × Duroc) pigs, 12 barrows and 12 gilts (initial body weights of 47.2 ± 4.2, and 43.6 ± 3.8 kg, respectively) were randomly allocated into a 4 × 2 factorial treatment experiment. Pigs were individually fed in 1.5 × 2.2 m pens, daily feed intake and pig's weight were recorded every 7 days. Treatments were related to the grain mixture of diet: 1) 100% sorghum, 0% corn (C0), 2) 65% sorghum, 35% corn (C35), 3) 35% sorghum, 65% corn (C65), and 4) 0% sorghum, 100% corn (C100). Diets were formulated with 16.2% CP, 0.80% Lysine, 0.62% Ca, and 0.50% P. Metabolizable energy content for treatments 1 to 4 were 3.22, 3.26, 3.31 and 3.37 Mcal/kg, respectively. Results were analyzed with the General Linear Model of SPSS, and means were compared using the Duncan test. Barrows had higher (P<0.1) ADG than gilts when they received C65 (1.085 *vs* 0.818 kg/d) and C35 diets (0.995 *vs* 0.839), but ADG was similar (P>0.1) between gender when diets contained either only sorghum (0.912 *vs* 0.919 kg) or corn (0.914 *vs* 0.974 kg/d for barrows and gilts, respectively). No treatment effects (P>0.05) were found for ADFI (3.602 kg/d) and F:G (3.95:1). The highest economic return by animal (P<0.1) was obtained for barrows fed the C35 diet, the lowest for gilts receiving C35 and C65 diets. In conclusion, feeding barrows with diets including a mixture of sorghum and corn, and gilts with either only sorghum or corn may improve the performance and economic return of swine production units.

Key Words: Pigs, Sorghum, Corn

T211 The effects of feeding diets naturally-contaminated with *Fusarium* mycotoxins on protein metabolism in late gestation and lactation of sows and the efficacy of a polymeric glucomannan adsorbent in preventing these effects. G. Diaz-Llano*, C. Caballero-Cortes, R. M. Friendship, and T. K. Smith, *University of Guelph*, *Guelph, ON, Canada*.

The feeding to swine of grains naturally contaminated with *Fusarium* mycotoxins reduces feed intake and increases body weight loss in

lactation. An experiment was conducted to investigate the effects of feeding grains naturally contaminated with *Fusarium* mycotoxins on the metabolic state of skeletal muscle of sows during late gestation and lactation, and to test the efficacy of a polymeric glucomannan mycotoxin adsorbent (GMA, Mycosorb, Alltech, Inc., Nicholasville, KY) in preventing these effects. A completely randomised block design, 32 sows, 8 sows per treatment was employed. Diets were corn, wheat and soybean meal based and were fed from 91 days of gestation until weaning on d 21 post farrowing. The treatments were: (1) control (C), (2) contaminated grains (CG) (3.6 ppm DON + 0.3 ppm 15-acetyl DON + 0.2 ppm zearalenone), (3) contaminated grains + GMA and (4) restricted to 80% of feeding control (RF). The studied variables were feed intake, body weight gain, gain: feed, total serum protein, urea and ammonia, and the ratios of RNA: DNA and protein: DNA in the triceps *bracii muscle*. Means were compared by contrasts and significance was declared at $P \leq 0.05$. Serum protein, urea, ADFI and ADG were not affected by diets, but ammonia was increased with CG and RF treatment and it was reduced with GMA in gestation. In lactation, ADFI was reduced with the feeding of CG and GMA. There were no effects of diet on RNA: DNA ratios in lactation. Protein: DNA was reduced in RF compared to C ($P = 0.04$). In conclusion the feeding of diets contaminated with Fusarium mycotoxins increased serum ammonia, and dietary supplementation with GMA prevented this effect. The reductions in muscle protein: DNA, an index of protein synthesis, were caused mainly by reductions in feed intake and were not directly caused by feed borne Fusarium mycotoxins.

Key Words: Gestating Sows, *Fusarium* Mycotoxins, Lactating Sows

T212 Effects of heat processing of corn and rice on serum ghrelin concentrations in young pigs. D. Menoyo[1], D. G. Valencia[1], V. Barrios[2], M. P. Serrano[1], B. Vicente[1], R. Lázaro[1], J. Argente[2], and G. G. Mateos*[1], [1]*Universidad Politécnica de Madrid*, *Spain*, [2]*Servicio de Endocrinología, Hospital Infantil Universitario Niño Jesús*, *Spain*.

Human and animal studies suggest a role for high glycemic index (GI) diet on feed intake mediated by endocrine signals. Ghrelin is a peptide with potent appetite-stimulating activity that might affect voluntary feed intake. In addition, ghrelin has the specific characteristic of having an acylated group on one of its serine residues (Ser 3), which affects its activity. We have previously reported that type (rice vs. corn) and processing (raw vs. cooked) of the cereal of the diet increases GI in young pigs. This effect might partially explain the increases in feed intake observed when rice replaces corn in pig diets. The present study was designed to elucidate the effects of cereal type and heat processing of the cereal on dynamics of serum ghrelin after a short-term fasting and re-feeding trial. Weanling pigs (BW = 8.10 ± 1.2 kg, n=9 per treatment) were individually penned and fed their respective experimental diets based on milk products, fish meal, and 52% of corn or rice either raw or cooked. Pigs received their experimental diets for two weeks and then they were deprived of food for 12h (start of the experiment, 0h). Afterwards they were re-fed *ad libitum* for 3h and deprived again of food for 6 extra-hours. Blood was collected at 0h, 3h, 6h, and 9h of the experiment. Ghrelin levels were quantified by RIA (Linco Research, St-Charles, MO). Ghrelin levels were not affected by dietary treatment ($P>0.10$), but were modified ($P<0.01$) by time, with a maximum (532 pg/ml) at 6h of the experiment. Analysis of the acylated ghrelin levels will provide further insights on the implication of this hormone in the appetite stimulating effects of rice.

Key Words: Weanling Pigs, Ghrelin, Heat processing

T213 Citric acid and thymol influence gastrointestinal microflora in pigs at weaning. A. Piva[1], E. Grilli*[1], M. R. Messina[1], S. Albonetti[2], V. Pizzamiglio[1], I. Cipollini[1], P. P. Gatta[1], and G. Zaghini[1], [1]*DIMORFIPA*, *Ozzano Emilia, Bologna, Italy*, [2]*DSPVPA*, *Ozzano Emilia, Bologna, Italy*.

Aim of this study was to investigate the role of citric acid (CA) and thymol on growth performance and gastrointestinal microflora in weaning pigs. Ninety-six Landrace × Duroc piglets weaned at 22 days of age (6.7 ± 0.8 kg BW) were divided into four groups of 4 replicates of 6 animals each and assigned to experimental dietary treatments: control diet (T1) or the control diet added with microencapsulated CA (T2), microencapsulated thymol (T3), and a microencapsulated blend providing the same amounts of CA and thymol of the other groups (T4) (EP 1391155B1; US 20040009206A1; Vetagro srl, Italy). Piglets were fed a two-phase diet (0-21 d, 22-42 d) and at 42 days 6 animals per treatment were sacrificed, the GI tract was removed and the contents of stomach, proximal jejunum, distal jejunum, caecum and colon were collected to be analysed for pH, NH_3, VFA, and lactobacilli, coliforms, and *C. perfringens* counts. Live weight at 0, 21 and 42 days was recorded; average daily gain, feed intake and feed conversion rate between 0-21, 22-42 and 0-42 days were calculated. All data were analyzed by ANOVA and differences were considered statistically significant at $P<0.05$. Thymol increased feed intake throughout the study (0-42d, +12.6% T3 vs T1, $P<0.05$); final weights were not different. Microencapsulated CA (T2) or thymol (T3) failed to change bacterial counts along the GI tract, whereas only the microencapsulated blend (T4) significantly reduced by 4 Logs coliforms in caecum compared to control fed piglets (T1= 6.73 ± 0.61, T4= 2.81 ± 3.12, Log CFU/g, $P=0.04$). These data suggests that microencapsulated thymol improved feed intake throughout the crucial 42 days of the post weaning period and that the individual microencapsulated compounds at the supplemented dose were not inhibitory, whereas properly coupled substances may exert a synergistic activity in modulating cecal microflora.

Key Words: Citric Acid, Thymol, Weaning

T214 Use of different soybean and fish meal protein sources in diets for young pigs. M. T. Sánchez[1], D. G. Valencia[1], M. P. Serrano[1], J. Sánchez[2], R. Lázaro[1], and G. G. Mateos*[1], [1]*Universidad Politécnica de Madrid*, *Spain*, [2]*Imasde Agropecuaria*, *Spain*.

A trial was conducted to compare three soybean protein (SOY) sources (SPC, a soy protein concentrate with 54.3% CP; SoyMAX, a high quality soybean meal from Owensboro crushing plant with 48.5% CP, and RSBM, a regular soybean meal with 46.8% CP), and three fish meal (FM) sources (LTFM, a FM spray dried at 70 °C with 71.2% CP; HQFM, a FM steam dried at 80 °C for 50 min with 64.9% CP, and SFM, a FM steam dried at 110 °C for 120 min with 60.7% CP) in piglet feeds on productivity from 23 to 43 d of age and apparent total tract digestibility (ATTD) of nutrients at 34 and 43 d of age. The

protein source tested replaced 5% of the protein provided by RSBM in all the diets. Each treatment was replicated six times (six piglets per replicate). Comparisons were performed to study the effect of protein source (SOY vs. FM), SOY source (SPC vs. SoyMAX vs. RSBM), and FM source (LTFM vs. HQFM vs. SFM). From 23 to 34 d of age pigs fed SOY were more efficient than pigs fed FM (0.91 vs. 0.96 g/g; P<0.05) but no effects were observed thereafter. For the entire experiment source of SOY did not affect performance, but the incidence of diarrhea tended to be lower in pigs fed SPC (P<0.10). Pigs fed LTFM were more efficient than pigs fed SFM, with pigs fed HQFM intermediate (1.04 vs. 1.16 vs. 1.10 g/g; P<0.05). The ATTD of dietary components increased with age. Pigs fed FM had better ATTD of ether extract than pigs fed SOY (P<0.001), but no effect was observed for the other nutrients. The ATTD was better for pigs fed SoyMAX than for pigs fed SPC (P<0.01), with RSBM intermediate. Also, ATTD of FM was the best for pigs fed LTFM (P<0.01). In summary, soy protein concentrate does not improve growth or nutrient digestibility as compared with soybean meal. Pigs fed spray dried fish meal are more efficient and have better digestibility of nutrients than pigs fed fish meal steam dried at 110°C for 120 min.

Key Words: Fish Meal Processing, Soy Protein Concentrate, Piglet Feeding

T215 Segregated early-weaning down regulates the expression of the small intestinal alkaline phosphatase. D. Lackeyram*, C. Yang, T. Archbold, and M. Z. Fan, *University of Guelph*, *Guelph, Ontario, Canada*.

The digestion of non-phytate organic sources of phosphates is effected by the small intestinal alkaline phosphatase (IAP). This enzyme also participates in the absorption of triglycerides as such it is also regarded as a marker enzyme for the functional development of the small intestine. The objectives of this study were to: (i) partition the tissue IAP activity into the brush border membrane (BBM) and intracellular fractions; (ii) examine IAP enzyme abundance in these cellular fractions and (iii) investigate changes in IAP mRNA expression. Ten suckling (SUC) and 10 weaning SEW) piglets, balanced for gender with an average BW of 3kg were used. The SUC group was marked at d 10 and allowed to suckle for 12 d and the SEW group was fed a corn and soybean meal starter-I diet for 12 d. In vitro enzymatic kinetic experiments of jejunal tissue using P-Nitrophenyl phosphate (0-10 mM) was used for enzymatic kinetic expeirment incubations. Quantitative real time RT-PCR was performed on intestinal tissues using the Quantitect SYBR Green RT-PCR kit with a Smart Cycler (Cepheid,CA). Weaning decreased (P<0.05) the maximal specific activity (Vmax, µmol/mg protein.min, n = 60) of IAP (SEW, 0.35±0.02 vs. SUC, 0.44±0.04; SEW, 0.66±0.01 vs. SUCK, 0.73±0.01) in both the tissue homogenate and the BBM, respectively. Similar decreases (P<0.05) were observed in the IAP protein abundance (arbitrary units) in the tissue homogenate (SEW, 1.75±0.27 vs. SUC, 3.33±0.70), intracellular (SEW, 0.79±0.06 vs. SUCK, 1.69±0.17) and BBM fractions (SEW, 0.69±0.12 vs. SUC, 1.89±0.48). Furthermore, SEW reduced (P<0.05) the IAP mRNA abundance (arbitrary units relative to ß-actin) by 2.4 fold (SEW, 0.06±0.01 vs. SUC, 0.14± 0.01). Pearson correlation analyses demonstrated correlations (P<0.05) between Vmax and IAP protein in both tissue homogenate and BBM fractions and between IAP protein and mRNA levels. In conclusion, early weaning down regulates gut IAP expression at the transcriptional and protein processing levels in the pig.

Key Words: Early Weaning, Intestinal Alkaline Phosphatase, Gene Expression

T216 The phosphorus-releasing efficacy of an *E. coli*-derived phytase in young pigs is dose-dependent and is not affected by the addition of a lipid-based coating added for pelleting stability. N. R. Augspurger*[1], A. M. Gaines[1], J. R. Danielson[2], and L. L. Southern[3], [1]*JBS United, Inc.*, *Sheridan, IN*, [2]*University of Wisconsin*, *Madison*, [3]*LSU Agricultural Center*, *Baton Rouge, LA*.

Two trials were done to determine the effect of increasing phytase activity on quantitative P-releasing efficacy of a bacterial-derived phytase (OptiPhos, JBS United, Inc.) in nursery pigs. Individually-fed pigs (n = 8 per treatment, initial BW = 10.2 [Trial 1] and 9.8 kg [Trial 2]) were fed P-deficient corn-soybean meal diets (0.075% available P, 0.60% Ca) supplemented with inorganic P (iP, monosodium phosphate) or phytase. At the end of each trial, a fibula was collected from each pig for determination of bone ash (% [BAP] and milligrams [BAC]). Standard-curved methodology was used to calculate P-release values for phytase. Trial 1 had 4 iP concentrations (0, 0.066, 0.133, or 0.20%) and 250, 500, or 1,000 FTU/kg phytase. In this trial, iP and phytase supplementation increased ($P < 0.01$) ADG, BAC, and BAP over the basal diet. Phytase at 250, 500, and 1,000 FTU/kg released 0.124, 0.140, and 0.179% P, respectively. Trial 2 had 3 iP concentrations (0, 0.075, or 0.15%) and 250, 500, or 1,000 FTU/kg of the phytase with a lipid-based coating that enhances thermo-tolerance at 85 °C, compared to 250 FTU/kg of the uncoated phytase. Supplementation of iP resulted in linear increases in ADG ($P = 0.051$) and BAC and BAP ($P < 0.01$). There was no difference ($P > 0.10$) between the uncoated or coated phytase at 250 FTU/kg for any response. For the coated phytase, BAC was increased ($P < 0.05$) with each increase in activity concentration, but BAP was greater ($P < 0.05$) for pigs fed diets containing 500 and 1,000 FTU/kg coated phytase compared to 250 FTU/kg. Quantitative P-release values for 250, 500, and 1,000 FTU/kg of an *E. coli*-derived phytase with a lipid-based coating were 0.132, 0.169, and 0.223%, respectively; 250 FTU/kg of the uncoated phytase released 0.130% P. These data demonstrate dose-dependent increases in quantitative P-releasing efficacy for an *E. coli*-derived phytase in pigs. The addition of a lipid-based coating to the phytase for pellet stability did not affect its efficacy in pigs.

Key Words: Phytase, Phosphorus, Pigs

T217 Evidence of a preference in piglets for an animal protein hydrolysate. D. Martínez-Puig*[1], M. Anguita[2], F. Baucells[2], E. Borda[1], J. F. Pérez[2], and C. Chetrit[1], [1]*Bioiberica S.A.*, *Barcelona, Spain*, [2]*Dpt. Ciència Animal i dels Aliments, Universitat Autònoma de Barcelona*, *Bellaterra, Barcelona, Spain*.

The transition in piglets from suckling to eating solid feed is associated with a critical period of underfeeding, suboptimal growth rate and increased risk of diarrhea. The objective of the current study was to investigate if the piglets may show a preference for the intake of

diets containing a specific protein concentrate ingredient. To test this hypothesis, we compared a hydrolysate of animal protein (Palbio Inicium™), and a hydrolysate of soy protein, or spray dried porcine plasma (SDPP). 96 piglets were weaned at 21 days of age and randomly subdivided into 3 groups of 32 pigs each. Piglets were distributed into 24 pens (8 replicates of pigs per group). Every group of piglets had the choice between two diets, resulting in three comparisons. In comparison 1, a diet containing SDPP (4%) was tested against a diet containing a soy protein hydrolysate (4%); in comparison 2, a diet containing the animal protein hydrolysate (Palbio Inicium™; 1%) and 3% of a soy protein hydrolysate was compared against the soy diet (4%); and in comparison 3 the diet containing Palbio Inicium™ (1%) was compared against the SDPP diet (4%). Feed intake was registered daily during 7 days after weaning. The percentage of preference (%) was calculated as the accumulated intake of the tested diet divided by the total intake. During the whole period no preference for SDPP diet (46.3%) compared to the soy diet was observed. Contrarily, the animal protein hydrolysate diet was significantly preferred to the soy diet from day 4 (59%; $P<0.05$) until day 7 (65.4%; $P<0.05$). Choice for the animal protein hydrolysate diet was numerically higher compared to the SDPP diet (58%) but differences failed to reach statistical significance. These results suggest that the palatability of a postweaning diet can be improved by incorporating a 1% of an animal protein hydrolysate.

Key Words: Piglet, Preference, Animal Protein Hydrolysate

T218 Effect of coarse ground corn, sugar beet pulp and wheat bran on the colonic morphology in growing pigs. M. Nofrarías*[1,2], M. Anguita[2], M. Roca[1,2], J. F. Pérez[2], and N. Majó[1,2], [1]*Centre de Recerca en Sanitat Animal (CReSA)*, *Bellaterra, Spain*, [2]*Universitat Autònoma de Barcelona*, *Bellaterra, Spain*.

The aim of this work was to evaluate the influence of different types of dietary fiber on the colonic digesta characteristics and intestinal morphology in growing pig. A total of 96 pigs (15±0.2 kg) were fed four experimental diets including a control group (CT) or the same diet including coarse milled corn (CC), 8% sugar-beet pulp (SBP) or 10% wheat bran (WB). Three experimental periods were considered (7, 21 and 42 days) and 8 animals per treatment killed at the end of each period. Proximal colonic digesta was analyzed for cytolytic capacity of the water digesta and microbial diversity. Histological study was performed in tissue samples from proximal colon. Cytolytic capacity of the colonic water tended to increase with the inclusion of WB in the diet ($P=0.091$). Moreover, in the third period, WB-fed pigs had a decrease in the colonic microbial diversity ($P<0.05$). In the early stages (day 7), diets with higher amount of fiber (CC, SBP and WB) increased the presence of inflammatory cells between crypts compared to CT fed pigs (2.42 vs. 1.85 cells; $P<0.05$). However, with time (days 21 and 42), inclusion of SBP in the diet lowered numbers of lymphocytes in the epithelium and in the lamina propia, and the presence of lymphoid nodules in the mucosa of the colon compared with other diets ($P<0.05$). The thickness of tunica muscularis was lower for SBP and WB pigs in the proximal colon ($P<0.05$), whereas no changes in crypt depth and numbers of mitoses were observed. The incorporation of fibrous ingredients in growing pig diets may induce changes on the digesta properties and histology of colonic mucosa. While WB reduced microbial diversity, the incorporation of SBP favoured the adaptation of the animals to the growing pig diet, as suggested by the lowering effect on indicators of mucosa inflammation.

Key Words: Dietary Fiber, Intestinal Histology, Pig

T219 Duodenal infusion of pancreatin to growing pigs fed phytase-supplemented, sorghum-soybean meal diets: Apparent ileal amino acid digestibility. S. Fierro, M. Cervantes*, W. Sauer, A. Morales, N. Torrentera, and A.B. Araiza, *ICA - Universidad Autonoma De Baja California*, *Mexicali, BC. Mexico*.

Phytates in feed ingredients appear to inhibit the activity of pancreatic enzymes in pigs. This experiment was conducted to determine if duodenal infusions of pancreatin, a mixture of lyophilized pancreatic enzymes, improves the apparent ileal digestibility (AID) of amino acids in pigs fed sorghum-SBM diets added with phytase. Eight barrows (Yorkshire-Landrace-Hampshire), average body weight of 38.3 ± 2.8 kg, fitted with two T-cannulas (one in duodenum and other in terminal ileum) were used. Treatments (T) were as follows: T1 = basal sorghum-SBM diet, 13.1% CP; T2 = basal diet supplemented with 1,000 phytase units per kg diet; T3 = as T1 plus pancreatin infusion (591 mg kg-1 of diet); T4 = as T2 plus pancreatin infusion (591 mg kg-1 of diet). Pancreatin was infused into duodenum at every feeding time using a 25-cc syringe. The study was conducted as a replicated 4x4 Latin square design. All diets were added with vitamins and minerals to meet the 1998 NRC standards for growing pigs. Chromic oxide was added to all diets as a digestibility indicator. The AID of essential AA for T1, T2, T3, and T4 were: Arg, 77.8, 78.1, 77.3, 79.0; His, 72.1, 71.4, 69.9, 72.2; Ile, 72.7, 72.1, 70.3, 71; Leu, 77.5, 76.8, 75.3, 76.9; Lys, 63.4, 64,0, 61.8, 60.7; Met, 69.6, 68.2, 66.0, 67.6; Phe, 75.7, 75.0, 73.5, 74.7; Thr, 57.0, 55.2, 54.9, 57.7; Val, 68.3, 67.5, 66.3, 67.4, respectively. There was no effect of duodenal infusion of pancreatin or phytase supplementation ($P > 0.10$) on the AID of essential AA. Also, there was no interaction ($P > 0.10$) between phytase supplementation and pancreatin infusion. The AID of essential AA was 3.2 percentage units higher than non-essential AA. These results indicate that the duodenal infusion of pancreatin does not improve the AID of AA of growing pigs fed sorghum-SBM diets supplemented with phytase.

Key Words: Pigs, Amino Acid Digestibility, Pancreatin

T220 Effect of dietary antibiotics and mannan oligosaccharides on growth performance, carcass characteristics and health of growing/finishing pigs. H. Bernal-Barragán*[1], E. A. Ruiz-Chávez[1], E. Gutiérrez-Ornelas[1], R. Ávalos-Ramírez[2], M. Cervantes-Ramírez[3], and F. Sánchez-Dávila[1], [1]*Facultad de Agronomía, Universidad Autónoma de Nuevo León*, *Marín, Nuevo León, México*, [2]*Fac. de Medicina Veterinaria y Zootecnia UANL*, *Unidad Mederos, Monterrey N.L. México*, [3]*Instituto de Ciencias Agrícolas UABC*, *Ejido Nuevo León, Valle de Mexicali, B.C. México*.

This study was conducted to evaluate the effects of a mannan oligosaccharide product (MOS) and antibiotic (BMD) on growth performance, carcass characteristics and health of growing/finishing pigs. Forty-eight (14 barrows and 32 gilts) crossbred (Landrace ×

Yorkshire × Duroc) pigs (43.5 ± 3.8 kg) allotted by sex and weight, were randomly allocated to one of four dietary treatments in a 2 × 2 factorial, with the factors being MOS (0 or 0.05%) and BMD (0 or 33 ppm). A Basal sorghum-SBM diet was formulated to meet the NRC 1998 standards for swine, and had no addition of pharmacological levels of cooper sulfate. The trial was conducted for 63 days during the summer (av. temperature 29.7°C, and relative humidity 62%). Results were analyzed with the General Linear Model of SPSS, and means were compared using the Duncan test. Average daily gain (0.775 kg/d), ADFI (2.414 kg/d) and F:G (3.12:1) were not affected (P>0.05) by the level of MOS or BMD. Pigs fed the diet added with both MOS and BMD, had higher ADG (P<0.05) than those fed the other three diets (0.855 *vs* 0.749 kg/d). By adding none or both of the additives, pigs had higher (P<0.05) carcass length at slaughter (75.1 *vs* 73.2 cm), than animals fed diets containing either MOS or BMD (Interaction MOS × BMD P<0.05). Pigs receiving BMD had higher (P<0.05) average fat depth than pigs with no BMD in their diet (30.3 *vs* 26.8 mm). Diets containing MOS alone had no effect on growth performance or carcass characteristics of growing/finishing pigs. Health condition of pigs was not affected by treatments. In conclusion, withdrawing BMD from the diet of growing/finishing pigs had no effect on performance or carcass characteristics. Adding MOS had a positive effect on ADG only if BMD was also provided in the diet.

Key Words: Pigs, Antibiotics, Mannan Oligosaccharides

T221 Effect of a dry organic acid blend on lactating sow feed intake and performance. J. Zhao*[1], R. J. Harrell[1], L. L. Greiner[2], X. Wang[3], G. L. Allee[3], F. Navarro[1], and C. D. Knight[1], [1]*Novus International Inc*, *St. Louis, MO*, [2]*Innovative Sow Solutions*, *Carthage, IL*, [3]*University of Missouri*, *Columbia*.

A total of 112 mixed parity (1, 2, or 3) lactating sows (PIC C22) were used to investigate the impact of a dry organic acid blend (DOAB) (ACTIVATE® Starter DA, registered trademark of Novus International, Inc., St. Louis, MO), containing 2-hydroxy-4-(methylthio) butanoic acid calcium, benzoic acid, and fumaric acid, on sow feed intake, wean to estrus interval, and litter growth performance. Sows were blocked by parity and randomly assigned to either a non-medicated basal corn-soybean diet, or the basal diet supplemented with 0.2 or 0.4% DOAB upon entry into the farrowing house. Sows were fed via a HOWEMA automatic feeding system 1.8, 2.7, and 3.6 kg for the day of farrowing, d 1 and d 2 post-farrowing, respectively, and ad libitum until weaning at 17±1 days of lactation. Daily feed intake was higher from 3 to 5 d post-farrowing with 0.4% DOAB supplementation (P < 0.05) compared to 0.2% or controls. Sows consumed 6.3, 6.3, and 7.2±0.3 kg/d feed from 3 to 5 d post-farrowing for the control, 0.2, and 0.4% DOAB, respectively. Feed intake was not affected by DOAB supplementation for the remainder of the study (P = 0.83). The wean to estrus interval was linearly reduced with DOAB supplementation (P < 0.05), with 9.2, 7.7, and 5.5±1.2 days for the control, 0.2, and 0.4% DOAB, respectively. Sow fecal E. Coli and C. perfrigens counts (10 sows/treatment) on d 3 and 10 post farrowing was not different among treatments (P > 0.26). No differences were observed between treatments on litter weights, number weaned, or number of fall behinds (P > 0.31). In summary, DOAB supplementation improved feed intake during 3-5 days postfarrowing and shortened the return to estrus interval.

Key Words: Organic Acid, Sow, Reproduction

Nonruminant Nutrition: Poultry Nutrition II

T222 Broiler performance and yield observed with enzyme supplementation and a corn matrix adjustment for energy. X. Sun*[1], C. Troche[1], A. McElroy[1], J. Remus[2], E. Wong[1], and C. Novak[1], [1]*Virginia Polytechnic Institute and State University*, *Blacksburg*, [2]*Danisco Animal Nutrition*, *Carol Stream, IL*.

Two studies were conducted to investigate the effect of a corn matrix adjustment and enzyme supplementation on broiler growth and performance from 0 to 49 days of age. A 2 × 2 factorial treatment design was used testing two corn matrix (CME) values for energy (actual ME vs. corn A with matrix increase of 138 kcal ME/ kg – trial 1; corn B with matrix increase of 125 kcal ME/ kg – trial 2) with or without enzyme supplementation (0.5 % Avizyme 1502 – AZ). For each trial, 1,440 Ross 708 male chicks were randomly assigned to one of four dietary trts (9 reps/trt and 40 chicks/ rep) on d 1. Body weight (BW) and feed intake (FI) were recorded at feed changes (d 14, 28, 37) and d 7 and 49. At d 28, subsets of birds were transferred to Petersime batteries to determine feed passage rate. At d 50 and 51, 54 birds per trt were processed to evaluate meat yield. Using corn B, an interaction was observed evaluating BWG with improvements noted when supplementing AZ with no matrix adjustment while reduced with a matrix adjustment to 35 d. The opposite was true using corn A. BWG was similar across trts from d 35 to 49 using either corn. FI followed BWG data using corn B. Using corn A, feeding matrix adjusted diets increased FI as compared to non adjusted diets from 37 to 49 days of age. Additionally, FI of broilers fed the AZ supplemented/ non adjusted diet ate less as compared to broilers fed the adjusted/ with AZ or non adjusted diet from 28 to 37 days of age. Overall, FCR in birds consuming non adjusted diets (corn A and B) was better (P ≤ 0.05) as compared to birds fed CME adjusted diets. Feeding corn A, percent tender was increased (P ≤ 0.05) with enzyme supplementation (4.80 vs. 4.62%). Additionally, percent fat pad was reduced (P ≤ 0.05) with a matrix adjustment for energy using corn A. In conclusion, decisions regarding matrix adjustments to utilize additional energy released with enzyme supplementation are dependant on corn source.

Key Words: Broiler, Enzyme, Matrix Energy Corn Source

T223 The effect of chitosan and natural mineral complex supplementation on egg production and egg characteristic in laying hens. J. S. Yoo*[1], Y. J. Chen[1], J. H. Cho[1], J. H. Lee[2], B. C. Park[2], and I. H. Kim[1], [1]*Dankook University*, *Cheonan, Choognam, Korea*, [2]*CJ Feed Inc*, *Incheon, Gyeonggi, Korea*.

This study was conducted to investigate the effects of dietary natural mineral liquid complex(NMLC) on egg production and egg characteristic in laying hens. NMLC is made of *Aretmisia princesm*

pinus, densiflora sieb and Biotite. In Exp 1, a total of two hundred fifty two laying hens were randomly allocated into seven treatments with six replications for six weeks. Dietary treatments included 1) CON(control), 2) M1 0.25(CON+1% chitosan+0.25% NMLC), 3) M2 0.25(CON+2% chitosan+0.25% NMLC), 4) M2 0.50(CON+2% chitosan+0.50% NMLC), 5) M3 0.25 (CON+3% chitosan+0.25% NMLC) and 6) M3 0.50(CON+3% chitosan+0.50% NMLC). During the experiment period, dietary NMLC treatments could improved in egg production, egg shell strength, egg shell thickness, yolk color, haugh unit and mineral ingredients of blood and yolk compared to CON(P<0.05). In conclusion, chitosan 3% showed higher egg production, egg shell strength and yolk color compared others(P<0.05). Also, NMLC 0.5% was more improvement than NMLC 0.25%. In Exp. 2, a total of two hundred forty birds were randomly allocated into four treatments with eleven replications for six wk. Dietary treatments included 1) CON(control) 2) M0.5(CON+3% chitosan+0.5% NMLC), 3) M1.0(CON+3% chitosan +1.0% NMLC) and 4) M1.5(CON+3% chitosan+1.5% NMLC). For overall period, M1.5 had improved egg production compared to others (P<0.05). However, M0.5 showed higher egg weight compared to other treatments(P<0.05). M1.5 showed a statistically improved egg shell strength and thickness compared to CON(P<0.05). Haugh unit was increased in CON and M1.0 compared to M1.5(P<0.05). Ca and Fe concentrations of blood was increased in M1.5 compared to CON(P<0.05). M1.5 improved K concentration of yolk compared to CON(P<0.05). In conclusion, 3% chitosan + NMLC supplementation in layer hen diet improved egg production, egg shell strength, egg shell thickness, Ca and Fe concentrations in blood and K concentration in yolk.

Key Words: Natural Mineral Liquid Complex, Egg Characteristics, Layer

T224 Effects of dietary delta-aminolevulinic acid supplementation on egg production, egg quality and blood parameters in laying hens. Y. J. Chen*[1], J. H. Cho[1], H. J. Kim[1], J. S. Yoo[1], Q. Wang[1], Y. Hyun[2], and I. H. Kim[1], [1]*Dankook University*, *Cheonan, Choognam, Korea*, [2]*Easy Bio System, Inc*, *Cheonan, Choognam, Korea*.

Effects of dietary delta-aminolevulinic supplementation on egg production, egg quality and blood parameters were examined in a laying hens feeding trail. Two hundred forty (Hy-line brown, 21 wk old) layers were randomly assigned to four dietary treatments with 10 replications (six layers in adjacent three cages). Dietary treatments were: 1) CON (basal diet), 2) ALA1 (CON + ALA 5 ppm), 3) ALA2 (CON + ALA 10 ppm), 4) ALA3 (CON + ALA 15 ppm). All diets were formulated to meet or exceed NRC (1994) recommendation for laying hens. Egg production and egg weight were not influenced by the ALA supplementation (P>0.05). Egg shell thickness and breaking strength were also not affected by the treatments (P>0.05). Egg yolk index was higher in ALA3 treatment than that of the CON treatment (P<0.05) at the end of 4 and 8 wk. Haugh unit was increased in ALA3 treatment compared with CON and ALA1 treatments at the end of 8 wk (P<0.05). However, yolk color unit was not affected by the ALA supplementation (P>0.05). Serum iron concentration was increased in the ALA2 added treatment compared with CON treatment (P<0.05). Similarly, total iron binding capacity was also higher in the ALA2 treatment than that of the other dietary treatments (P>0.05). The difference of total protein between 8 and 0 wk was higher in ALA2 treatment than CON treatment (P<0.05). No significant effects were observed on Hb, albumin, WBC, RBC and lymphocyte concentrations (P>0.05). In conclusion, dietary ALA supplementation can positively affect egg yolk index, haugh unit and serum iron concentration.

Key Words: Delta-Aminolevulinic Acid, Egg Quality, Laying Hens

T225 Effect of dietary lipids and time of feeding on immune tissue n-6 and n-3 fatty acid distribution during lipopolysaccharide challenge in broiler chickens. D. Gonzalez*, A. S. Abd El-Hakim, M. P. Goeger, and G. Cherian, *Oregon State University*, *Corvallis*.

Due to the distance of shipment or delays in shipment, newly hatched chicks are often subjected to a 48 to 54 hr delayed access to feed and water. Delayed access to feed has been reported to reduce growth and development of the small intestine, reduce organ weights and a lower final body weight. The current study investigated the effect of early vs. late access to feed and dietary lipids on lipopolysaccharide (LPS)-induced alterations in fatty acid metabolism in broiler birds. A total of sixty chicks were used for the study. The chicks were fed a high or low n-3 diet within 5 hrs of hatching (early) or after 24 hrs of hatching (late). LPS injection led to a decrease in total n-6 fatty acids in the liver and spleen when compared with non-injected birds (P<0.05) in all treatments. Feeding high n-3 diets resulted in an increase in n-3 fatty acids in the spleen and liver tissue when compared to low n-3 when exposed to LPS challenge (P<0.05). Time of feeding significantly influenced different parameters in chicks exposed to challenge. When fed late, lower n-6 fatty acid was observed in liver tissue of both high and low n-3 diets than early-fed birds (P<0.05). Plasma non-esterified fatty acids were lowest in high n-3 diet birds fed early (P<0.05). The spleen tissue total fat content was highest in low n-3 birds fed late (P<0.05). There was no difference in the final body weight or organ weights of birds (P>0.05). During inflammation, lipid substrates for the activated immune system are provided by fatty acids. Therefore, dietary and management strategies directed at attenuating immune tissue lipid content may prove beneficial in reducing inflammatory responses and in increasing production performances in broiler chickens.

Key Words: n-3 Fatty Acid, Inflammation

T226 Fiber component type and level affect DDGS nutrient digestibility. M. K. Manangi*[1], C. N. Coon[1], E. E. M. Pierson[2], and M. Hruby[2], [1]*University of Arkansas*, *Fayetteville*, [2]*Danisco*, *St. Louis, MO*.

Due to the increase in production of ethanol from corn, there has been an increase in the availability of distillers dried grains with solubles (DDGS) in US poultry feeds. Globally, the usage of DDGS in poultry feeds is also increasing. In many cases, the practical inclusion of DDGS has been less than science-based recommendations because of the possible impact of its batch-to-batch nutrient variability on poultry performance. A study was conducted to quantify the in vitro characteristics of various samples of DDGS with NIR measurements and correlate these with determined in vivo assays. Each of the seven DDGS samples originated from the same lot of corn. Samples were subjected to proximate, fiber and mineral analyses. Additionally, all DDGS samples were precision-fed to 7 market-age broilers per treatment and total excreta collected during a 48 hours post-feeding

period. There was a strong positive correlation (r = 0.86; P < 0.05) between DDGS dry matter (DM) digestibility and TME. Of the fiber components analyzed, the order of strength for correlations of their in vitro determination with dry matter digestibility (from highest to lowest) was for NDF (r = -0.86; P < 0.05), crude fiber (r = -0.81; P < 0.05), hemicellulose (r = -0.79; P < 0.05) and ADF (r = -0.02; P > 0.05). This information could allow for a more reliable DDGS screening when evaluating nutrient digestibility and ME of this ingredient.

Key Words: DDGS Digestibility, Fiber, TME

T227 Extraction of saponins from guar meal. R. Kakani*, O. Gutierrez, A. Haq, and C. A. Bailey, *Texas A&M University*, *College Station*.

Two different methods were evaluated for extracting saponins from guar meal. In one method 25 grams of guar meal were placed in cellulose extraction thimbles and refluxed with 250 ml methanol for 24 hrs using Soxhlet extraction apparatus. In the second method, 25 grams of guar meal was refluxed directly for 3.5 to 4 hrs in equal volumes of water and absolute ethanol (125 ml of each). A roto-evaporator was used to evaporate the methanol extract to dryness and then approximately 100 ml of distilled water was added back. After filtering the solids from the ethanol-water extract, the ethanol was evaporated with the roto-evaporator leaving a volume of approximately 100 ml. The extracts were transferred to separatory funnels, equal volumes of n-butanol added and after vigorous shaking the solutions were left to partition overnight. The upper, saponin-rich n-butanol fractions were collected separately and the remaining aqueous fractions were partitioned two more times with n-butanol. The pooled n-butanol fractions were next evaporated to dryness, a little water added and then either freeze dried or immediately subjected to preparative reverse phase C-18 (octadecylsilyl coated silica) flash chromatography. The average yield of the freeze dried n-butanol partitions (4 replicates) was 7.34% and 4.91% for the methanol and ethanol methods respectively. These extracts were next evaluated for hemolytic activity using serial dilutions of 3 mg freeze dried extract per ml isotonic saline. Chicken RBCs (100 µl whole blood) were added to 2 ml of the serial diluted isotonic saline and allowed to sit at room temperature for 2 hrs. Both the extracts were hemolytic at concentrations greater than 750 µg/ml.

Key Words: Guar Meal, Saponins Extraction and Yield, Hemolysis

T228 Effects of corn-, wheat-, and flax-based broiler diets with or without enzyme supplementation on proliferation of *Clostridium perfringens*: *In vitro* study. X. Wang*, G. Blank, and B. A. Slominski, *University of Manitoba*, *Winnipeg, Canada*.

Clostridium perfringens is the major predisposing factor for necrotic enteritis in broiler chickens. In this investigation the individual growth of five *C. perfringens* strains was examined using supernatants prepared from either digested or non-digested corn or wheat-based diets mixed with thioglycollate broth and supplemented with or without exogenous carbohydrase enzymes. Following incubation at 40°C for 6 h increases in growth were determined. Overall, compared to the control which consisted of thiogycollate broth plus inocula, the level of vegetative growth was higher with the supernatants. However, among the five strains evaluated no clear pattern emerged with regards to vegetative growth in any of the supernatants regardless of enzyme supplementation. Spore germination of a cocktail consisting of three *C. perfringens* strains was similarly investigated. In all supernatants near complete germination of spores was evident within three hours. Germination was followed by vegetative growth which appeared lowest in the corn-based diet supernatant. Growth following 6 h at 40°C of a five strain cocktail of *C. perfringens* in digesta obtained from broilers fed corn-soya, wheat-barley or flax diets was also investigated. In all cases vegetative growth was not observed. Instead, populations were observed to decrease gradually; the highest and lowest survival occurred with the flax and corn-soya based digesta, respectively.

Key Words: *Clostridium perfringens*, Broiler Diets, Enzyme

T229 Influence of processing conditions of fish meal on digestibility of dietary components in broilers at 21 days of age. A. de Coca-Sinova, A. P. Bonilla, E. Jiménez-Moreno, R. Lázaro, and G. G. Mateos*, *Universidad Politécnica de Madrid*, *Spain*.

Bacterial contamination, in particular Salmonella spp. contamination, limits the use of fish meal (FM) in prestarter diets for broilers. In consequence, FM by–products are generally processed under severe heat conditions (100° C for 120 min) to reduce bacteria load. We studied the effect of processing FM under different time and temperature conditions on total tract apparent retention of nutrients (TTAR) and AME_n of diets in broilers at 21 d of age. There were six dietary treatments that differed in the type of FM used to replace 5% of the crude protein of the diet. There were a control diet (SFM) that included 8.0% of standard FM (100° C for 120 min) and a positive control diet (FMLT) that included 7.1% of a spray dried FM (70° C). In addition, there were four extra diets in which the rendered FM was steam–processed according to a factorial combination of temperature (80° C vs. 90° C) and time (50 vs. 90 min). Each treatment was replicated eight times (10 chicks caged together). The experimental design was completely at random and data were analysed by using a protected t–test and two non–orthogonal contrasts; 1) FMLT vs. SFM and 2) influence of temperature (80 vs. 90° C) and time (50 vs. 90 min) and their interaction. The TTAR of DM, organic matter, nitrogen (N), and AME_n of the diets were determined at 21 d of age. Digestibility was best in broilers fed FM LT or FM processed at 80° C for 50 min. Time but not temperature reduced TTAR ($P \leq 0.01$). The TTAR of all dietary components and AME_n of the diets were higher for FM heated for 50 min than for FM heated for 90 min (69.2% vs. 65.4% for N and 3,041 vs. 2,976 kcal/kg for AME_n, respectively; $P \leq 0.01$). We conclude that digestibility of dietary components is best for spray dried fish meal and that increasing processing time from 50 to 90 min to reduce microorganism load and Salmonella spp. counts might reduce the quality of fish meal in prestarter broiler diets.

Key Words: Fish Meal Digestibility, Processing Conditions, Broiler Chick

T230 Use of activity staining for monitoring site of β-glucanase activity in the gastrointestinal tract of broiler chickens. A. A. Sadeghi*[1] and P. Shawrang[2], [1]*Islamic Azad University*, *Tehran, Iran*,

[2]*Research Center for Agriculture and Medicine, Atomic Energy Organization of Iran*, *Karaj, Iran*.

Ninety day-old broilers were selected and randomly allocated to diet based soybean meal-corn without or with β-glucanase supplementation. At 3 and 6 wk of age, fifteen chickens from each treatment were slaughtered and the crop, gizzard, duodenum, jejunum and ileum contents were emptied and collected for electrophoresis and activity staining. The normal spectrophotometer method for β-glucanase was conducted on collected samples of all treatments. Proteins extracted from the various digesta samples were resolved using SDS-PAGE using 12.5% and native-PAGE using 7% polyacrylamide in the running gel. After SDS-PAGE, the gel was stained with Coomassie blue R-250 and destained. After native-PAGE, the gel related to β-glucanase activity stain was dipped into Lichenan (1.0 g/L solubilized with heat in 100 mM sodium acetate buffer, pH 5.0) and incubated at 50°C for 10 h. β-glucanase activity in native-PAGE gel was detected by overlaying the gel with 2% agar dissolved in above buffer, containing 0.3% congo red for 30 min. Fixation was completed with dilute acetic acid (1:9 v/v with water) for 15 min. Data were analyzed as a completely randomized design using the GLM procedure of SAS (1996). The normal spectrophotometer method failed to detect exogenous β-glucanase activity in the diet as well as in the digesta of crop, proventriculus, gizzard, duodenum and jejunum of broiler chickens fed the β-glucanase diet. Exogenous β-glucanase protein was detected by SDS-PAGE in the enzyme diet as well as in the digesta. Enzyme activity was detected by the activity stain native-PAGE assay in the enzyme diet and the digesta collected from the crop, gizzard and duodenum with the exception of jejunum and ileum. β-glucanase activity in digesta from the crop and proventriculus was higher than that from gizzard and small intestine ($P<0.05$). No activity detected in the small intestine. The result of the study suggests that the activity stain assays allow the detection of low levels of exogenous β-glucanase activity in the diet as well as in the digesta collected from the gastrointestinal tract of the broiler chicken.

Key Words: Native-PAGE, β-glucanase Activity, Broiler Chickens

T231 Differential developmental gene expression of nutrient transporters in the small intestine of male and female chickens from lines selected for high or low juvenile bodyweight. C. R. Miller*, P. B. Siegel, K. E. Webb, Jr., and E. A. Wong, *Virginia Polytechnic Institute and State University*, *Blacksburg*.

The objective of this study was to evaluate the developmental gene expression of nutrient transporters in the small intestine of male and female chickens from lines that had undergone long term selection for high (HWS) or low (LWS) 8-wk body weight. Nutrient transporters investigated were the peptide transporter PepT1, amino acid transporter EAAT3, and monosaccharide transporters GLUT5 and SGLT1. Chicks were reared in batteries with ad libitum access to feed and water. Chicks were weighed and killed on embryonic d 20 (e20), d of hatch (DOH with no access to feed), and d 3 (D3), d 7 (D7), and d 14 (D14) post hatch. RNA was extracted from duodenum, jejunum, and ileum from four males and four females from each line and time point except female D7 (n=2). Expression of nutrient transporters was assayed by real time PCR using the relative quantification method. There was a sex x age interaction in PepT1 gene expression with peak PepT1 expression at a younger age in females than males ($P = 0.0002$). Expression of SGLT1 was higher in females than males ($P < 0.0001$) with a sex x age interaction ($P < 0.0001$). Females induced SGLT1 gene expression on DOH which was maintained through D14. In contrast, SGLT1 gene expression in males gradually increased through D7 and then decreased to DOH levels by D14. Gene expression of EAAT3 and GLUT5 was not different in males and females. These results indicate that expression of PepT1 and SGLT1 are differentially expressed in male and female chickens regardless of selection for high or low juvenile body weight. These results also show a sexual dimorphism in the capacity to absorb peptides and glucose from the intestine, which has implications for the poultry industry with regard to diet formulations for straight-run and sex-separate grow-out operations.

Key Words: Chicken, Nutrient Transporters, Small Intestine

T232 Effect of main cereal of the diet and particle size of the cereal on productive performance and egg quality of brown laying hens in early phase of production. H. M. Safaa[1,2], E. Jiménez-Moreno[1], B. Vicente[1], R. Lázaro[1], X. Arbe[3], and G. G. Mateos*[1], [1]*Universidad Politécnica de Madrid*, *Spain*, [2]*Animal Production Department, Faculty of Agriculture*, *Cairo University, Egypt*, [3]*Cantos Blancos, S.L*, *Guadalajara, Spain*.

A total of 960 Lohmann Brown laying hens was used to study the effect of the main cereal (corn vs. wheat) of the diet and mean particle size (MPS; hammer milled to pass through a 6–, 8– or 10–mm screen) of the cereal on productive performance and egg quality from 20 to 48 wk of age. The six diets were isonutritive and were based on soybean meal, sunflower meal, soy oil, and either corn or wheat. They contained 2,750 kcal AME_n /kg, 16.5% CP, 0.80% total lysine, and 0.40% total methionine. The experimental design was completely at random with six treatments arranged factorially (two cereals and three MPS). Each treatment was replicated eight times (20 hens per replicate). Productive traits were recorded every four weeks and egg quality was measured at 48 weeks of age. Mean particle size of the experimental diets were 935, 1,126 and 1,411 μm for the corn diets and 1,078, 1,262 and 1,335 μm for the wheat diets, ground at 6, 8, and 10–mm, respectively. For the entire experiment the only significant effect on productive traits observed was for feed intake ($P \leq 0.001$) that was greater for hens fed coarse ground cereals (10–mm) than for hens fed fine ground cereals (8– or 6–mm). Also, from 45 to 48 weeks of age hens fed corn had higher proportion of large eggs (≥ 63 g) than hens fed wheat (84.5 vs. 79.4%; $P \leq 0.05$) but no differences were detected in any other period. Dietary treatment did not affect percentage of broken, shell–less, and dirty eggs ($P \geq 0.10$). Percentages of shell, yolk, and albumen, and albumen and shell quality were similar for all treatments ($P \geq 0.10$). We conclude that neither type of cereal nor particle size affect productive performance or egg quality of young hens, except for feed intake that was increased with the coarser particle size.

Key Words: Cereal, Particle Size, Laying Hen Performance

T233 Evaluation of additives in chicks challenged with necrotic enteritis. J. L. Shelton*, A. R. Garcia, and D. W. Giesting, *Cargill Animal Nutrition*, *Elk River, MN*.

Two experiments (EXP) were conducted at the Cargill Animal Nutrition Innovation Center to determine the effect of additives on growth

performance in chicks challenged with Necrotic Enteritis (NE). Both EXP were conducted using battery cages and chicks (6 per pen) were housed from hatching to 21 d (EXP 1) or 28 d (EXP 2). Initial and final body weights (BW) were 40 g and 774 g for EXP 1 and 39 g and 1,248 g for EXP 2. Feed intake and BW were measured weekly for determination of gain and feed efficiency. Chicks had ad libitum access to feed and water. Chicks were inoculated through the feed with coccidia (*E. acervulina*, *E. maxima*, and *E. tenella*) on d 9 and then with*Clostridium perfringens* on d 14, 15, 16, and 17. In both EXP, the treatments included an unchallenged negative control (NC, no additives), a challenged NC, and a challenged positive control (with added virginiamycin, Vm). The additives that were tested in these EXP were *Bacillus* (B), a plant extract (PE), mannan oligosaccharide (M), a prebiotic added at a high (PREH) and a low (PREL) level. In both EXP, adding Vm to the diet of challenged birds improved growth performance relative to those fed the NC. In EXP 1, during the challenge period chicks fed B, B+PE, M, or B+PE+M had increased gain:feed ($p < 0.05$) relative to those fed the NC. The 3-way combination of B+PE+M produced numerical increases in ADG and gain:feed relative to B or M fed alone or the 2-way combinations of B+PE or B+M. In EXP 2, during the challenge period chicks fed B, PREL, PREH, B+PREL had increased ($p < 0.05$) ADG relative to those fed the NC. Also, chicks fed the PREL and B+PREL had increased ($p < 0.05$) gain:feed relative to those fed the NC. For the overall growth period, chicks fed the combination of B+PREH+PE had increased ($p < 0.05$) gain:feed relative to those fed the NC diet. Results from these studies indicate that combining additives of different types could improve performance in chicks challenged with NE, but it is important to choose additives with complementary modes of action.

Key Words: Necrotic Enteritis, Probiotic, Plant Extract

T234 Effects of dietary genistin on performances, organ weight and bone development in young male chicks. G. D. Kim*, J. H. Han, and K. M. Chee, *Korea University*, *Seoul, Korea*.

Genistin together with genistein, daidzin and daidzein is one of the isoflavones (ISF) in soybean meal, a major dietary protein source for poultry. ISF are diphenolic compounds and naturally occurring phytoestrogens. Some of the phytoestrogenic effects of the ISF include anabolic influence on bone metabolism in ovariectomized rats, and growth promoting in pigs. Present study was conducted to investigate effects of dietary genistin, a glucosidic form, on growth performances, bone development, organ weight and secondary sexual development in male chicks. One hundred and twenty eight, d-old male chicks (Hy-Line) were distributed at random in 4 replicates of 8 birds per treatment. A purified-type basal diet consisting of soy protein concentrate (low in ISF) as the only protein source, was supplemented with 4 levels (0, 250, 450, and 650 ppm) of genistin (purity 85%). Dietary Ca level was limited to 50% of the NRC to find out any effects of the genistin on bone development. Feed intake, body weight gain, and feed/gain ratio of the birds during the 3 wk feeding period were not affected by the genistin intake. Average weights of comb, liver, thymus, and F-sac expressed as % body weight at 7th day of the feeding were not different among the dietary grops. However, testicle weights of the birds fed the diets containing the genistin 450 and 650 ppm were significantly lighter (22 & 26 mg) compared to that (32 mg) of the control birds, although the difference disappeared later. Thymus weight of the birds fed the 450 ppm genistin diet for 3 wks was significantly lighter ($P<0.05$) than that of the control (387 vs. 529 mg). Serum alkaline phosphatase activity tended to increase as more genistin intake was consumed. In conclusion, the genistin in purified form seems to have some biological effects in male chicks without changing the overall growth performances.

Key Words: Genistin, Performance, Testicle Weight

T235 Dietary persimmon peel powder and its tannin extract reduce the content of hepatic lipids in laying hens. C. W. Kang*[1], Y. K. Shin[2], S. J. You[1], and B. K. An[1], [1]*KonKuk University*, *Seoul, Korea*, [2]*MK Bioscience Co. Inc.*, *Suwon, Korea*.

The persimmon peel, which is a by-product of dried fruit and juice, has been known as a good source of nutritional antioxidant vitamins, polyphenols and dietary fibers. This experiment was undertaken to evaluate the dietary effects of persimmon peel powder (PP) and its soluble tannin extract (ST) on laying performance, egg quality and physiological characteristics in laying hens. A total of two hundred, 60-wks-old, Hy-Line Brown layers were divided into 5 groups and fed the each experimental diet containing PP 0.15%, PP 0.50%, ST 0.075%, or ST 0.25%, respectively, for 6 wks. There were no significantly differences in the egg production, daily egg mass and feed intake among the groups. The yolk color and eggshell color were significantly improved by the addition of PP and ST into layer diet. Haugh units in PP and ST groups were significantly ($P<0.05$) higher during a week of storage. The concentrations of hepatic total cholesterol, triacylglycerol and phospholipid in hens fed the diet containing PP or ST tended to be reduce as compared to those of the control. The profiles of serum lipid fractions and intestinal microflora were not affected by dietary either PP or ST. In conclusion, the feeding of PP and ST improved the yolk and eggshell colors and Haugh unit during storage. The results also suggested that PP and ST can be used as valuable feed additives for reducing hepatic lipid contents without harmful effects on overall productive performance and physiological responses in laying hens.

Key Words: Persimmon Peel Powder, Soluble Tannin Extract, Hepatic Lipid Contents

T236 Efficacy of a bacillary probiotic in broilers. M. I. Gracia[1], E. Esteve-García[2], P. Cachaldora[3], T. Marubashi[4], E. McCartney[5], and P. Medel*[1], [1]*Imasde Agropecuaria, S.L.*, *Pozuelo de Alarcón, Spain*, [2]*IRTA*, *Constantí, Spain*, [3]*COREN*, *Ourense, Spain*, [4]*Calpis Co Ltd.*, *Tokyo, Japan*, [5]*Pen&Tec Consulting*, *Sant Cugat del Vallès, Spain*.

Four experiments involving 5,524 male broilers in 126 replicates evaluated the efficacy of a bacillary probiotic (Calsporin®, Calpis Co Ltd.) containing 1×10^{10} viable spores of *Bacillus subtilis* C-3102 per g. A completely randomized design was applied in each study using two experimental treatments: 1) basal diet (control), and 2) basal diet with 50 mg/kg of probiotic (supplying 5×10^5 CFU per gram feed) in both starter and grower phases. Two studies used mash feeds and two studies used pelleted feeds. The experimental data were tested for homogeneity, pooled and combined in a meta-analysis. Parameters selected were body weight (g) at 21 and 42 d of age, mortality (%), weight gain (g/d), feed intake (g/d) and feed efficiency (feed/gain) at 1-21, 22-42 and 1-42 d of age, and European Production Efficiency Factor (EPEF) at 1-42 d of age. Probiotic supplementation and

experiment were considered as main effects. At 21 d of age, the broilers fed probiotic weighed 3.2% more than controls (806 *vs* 832 g; P<0.01), and 1.6% more at 42 days of age (P=0.056). Mortality was considered normal (mean 6.4%) in the experimental models used (feeds without coccidiostats and antibiotics, broilers in two studies bedded on once-used litter) and was unaffected by treatment. From 1 to 21 d, the probiotic increased growth (36.4 *vs* 37.6 g/d; P<0.01) and feed intake (59.2 *vs* 60.4 g/d; P<0.05). From 22 to 42 d probiotic supplementation decreased feed to gain ratio (2.02 *vs* 1.96 feed/gain; P<0.05). Over the global period, broilers fed the probiotic grew faster (61.2 *vs* 62.2 g/d; P=0.055), converted better (1.90 *vs* 1.85 feed/gain; P<0.05), and showed better EPEF values (303 *vs* 317; P<0.01) than controls. No interaction between probiotic supplementation and experiment was found, indicating that the effect of the probiotic was homogeneous across trials. In conclusion, these data provide evidence that this probiotic improves broiler performance at a dose of 50 mg/kg.

Key Words: *Bacillus subtilis*, Probiotic, Broilers

T237 Expression profiling of the solute carrier gene family in chicken intestine. H. Li*[1], E. R. Gilbert[1], Y. Zhang[2], O. Crasta[2], D. Emmerson[3], K. E. Webb Jr[1], and E. A. Wong[1], [1]*Virginia Polytechnic Institute and State University*, *Blacksburg*, [2]*Virginia Bioinformatics Institute*, *Blacksburg, VA*, [3]*Aviagen*, *Huntsville, AL*.

The members of the solute carrier (SLC) family are membrane-associated transporters that facilitate the passage of solutes across cell membranes and play an important role in absorption and distribution of nutrients across the small intestine. Compared to humans, little information is available on the developmental expression of SLC gene family members in chickens. The objective of our research was to determine the mRNA expression profile of the entire SLC gene family in the chick small intestine from late embryogenesis until 2 wk posthatch using Affymetrix chicken genome microarrays. Small intestines from 84 male chicks were collected on embryonic d 18 (e18) and 20 (e20), d of hatch, and d 1, 3, 7, and 14 posthatch. There were 162 SLC genes belonging to 41 SLC families expressed in the chicken small intestine. Fifty-nine SLC transporter genes showed at least a two-fold change (P < 0.01) in expression between e18 and d14, of these 26 showed at least a five-fold change (P < 0.01). The majority of transporters (103/162) showed less than a two-fold change in expression from e18 to d14 posthatch. Forty eight SLC genes showed upregulation (> two-fold) and 11 SLC genes showed downregulation (> two-fold) between e18 and d14. The glucose transporter SLC2A2 showed the greatest upregulation (104-fold) and the organic cation transporter SLC22A13 showed the greatest downregulation (16.5-fold) from e18 to d14. These results enhance our understanding of the relationship between SLC gene expression and the changes in chicken intestinal absorptive function at hatch as the chick shifts from nutrition based on a lipid-rich yolk to exogenous carbohydrate-rich feeds.

Key Words: Solute Carriers, Chicken Intestine, Microarrays

T238 Effects of Versazyme™ on ileal micro-architecture in young broilers as measured by histomorphometrics and scanning electron microscopy. C. C. Chiang[1], M. Chichlowski[2], R. Qiu*[2], J. Croom[2], L. Daniel[2], and J. Shih[2], [1]*National Chung Hsing University*, *Taiwan*, [2]*North Carolina State University*, *Raleigh*.

Versazyme™, a microbial keratinase preparation (400,000 U/g) that enhances protein digestion in poultry, has been previously found to alter intestinal muscle thickness when fed as a supplement to young broilers. To further investigate the effects of Versazyme™ on intestinal structure, 30 male broiler chicks were fed a standard starter diet (22% CP;CON) and 30 fed the starter diet plus 0.1% Versazyme™ (VZ) for 20 d. At hatch (day 0) and at days 3, 6, 14 and 20 post-hatch, six birds from each treatment group were euthanized and sections of the ileum were fixed and embedded in paraffin, sectioned and stained with hematoxylin and eosin in preparation for histomorphometric analysis using a computerized microscopic image analyzer. Histological parameters measured included villus height, villus perimeter, mid-villus width, crypt depth, external muscle layer thickness and height of enterocytes at mid villus. Adjacent pieces of tissue were fixed in glutaraldehyde and osmium tetroxide and examined for surface changes on villi, enterocytes and goblet cells using scanning electron microscopy (SEM). Although changes in histological parameters varied with age ($p \leq .05$), no VZ or age x treatment changes were noted ($p \geq .05$). SEM observations demonstrated several differences in the villi surface between CON and VZ. The surface of villi from VZ birds exhibited highly undulating surfaces with large and deep clefts as compared to CON villi. Furthermore, the surface of VZ villi contained large numbers of crater-like spots or pits, found on the surface of enterocytes or cells adjacent to enteroctyes. It is unclear whether these craters are the site of mucus secretion by goblet cells or represent structural erosion of the epithelial surface. Other changes noted were VZ villi microvilli numbers appeared greater than those of CON. Additionally, VZ villi appeared to have less mucus and mucus-associated bacteria than CON. Although Versazyme™ did not alter the dimensions of major histological features in the ileum of growing broilers in the present study, it did alter the surface characteristics of the villi.

Key Words: Keratinase, Versazyme, Intestinal

T239 Effect of a direct fed microbial on oxidative stress in the ileal and cecal epithelia of broilers. R. Qiu*[1], C. Ojano-Dirain[2], W. G. Bottje[2], C. Chiang[3], M. Chichlowski[1], J. Croom[1], L. Daniel[1], and M. Koci[1], [1]*North Carolina State University*, *Raleigh*, [2]*University of Arkansas*, *Fayetteville*, [3]*National Chung Hsing University*, *Taiwan*.

Two trials were conducted to elucidate the effects of broiler supplementation with Primalac®, a direct-fed microbial supplement (DFM), on cellular oxidative stress in the ileum and cecum. In Trial 1, eighteen broiler chicks (6 chicks per treatment) were fed either a starter pullet diet (17.4% CP; CON), CON + salinomycin (50 ppm; SAL) or CON + Primalac® (0.3%; DFM) for 21 days. At d21, broilers were euthanized and ileal mucosa was sampled. No treatment effects on mitochondrial oxidative stress as measured by increased carbonyl (CARB) concentrations (an index of protein oxidation) were found in ileal mucosa. Trial 2 was conducted as Trial 1 with the following changes. Chicks were fed a broiler starter diet (22% CP). Treatments were CON and DFM (6 chicks per treatment) and at d21, whole ileal tissue, ileal mucosal and cecal epithelial membrane lipid oxidative stress were estimated by malondialdehyde (MDA) concentrations. No differences in MDA were noted in mucosal preparations. DFM decreased whole ileal MDA concentrations by 69% (p= 0.02; .06 and .22 ηmol /μg protein, respectively) as compared to CON. Cecal MDA concentrations increased 124% with DFM as compared to CON (p=.02; 0.068 vs. 0.152 ηmol /μg protein, respectively). These

data suggest that the DFM, Primalac®, has selective antioxidant and pro-oxidative effects on the membranes of ileal enterocytes and cecal epithelial cells. The DFM effects on ileal enterocytes and cecal epithelia may be due to the extent of fermentation activity occurring in digesta at these sites within the digestive tract.

Key Words: Oxidative Stress, Direct Fed Microbial, Gastrointestinal

T240 Influence of *in ovo* feeding on turkey poult quality. J. E. de Oliveira*, P. R. Ferket, M. J. Wineland, and E. O. Oviedo-Rondon, *North Carolina State University*, *Raleigh*.

The quality of day old turkey poults is critical to their survival during the first few days after hatch. Tona et al. (2003) proposed a quality scoring method based on external characteristics like activity, appearance, retracted yolk, eyes, legs, navel, remaining membrane and remaining yolk, believed to describe poult quality. Leg shank relative asymmetry, a measure of early bone development that could influence the incidence of subsequent leg problems, is another indicatory of poult quality. *In ovo* feeding (IOF), shown to promote hatchling development, may improve poult quality and thus reduce the number of culls and early mortality. Two hundred and fifty Nicholas turkey eggs of similar egg weight (82.5±10g) were incubated in a single-stage incubator set at 38C. At 24 days of incubation, half of the eggs were injected into the amnion with 0.4 ml of a nutritive solution, while the other half served as untreated controls. At day of hatch, percent hatchability was recorded, and then poult quality score, body weight (BW), remaining yolk sac (RY), yolk free body weight (YFBW), poult length (PL) and shanks relative asymmetry (RA) were determined on all hatched poults. There were no significant treatment effects on % hatchability, BW, RY, YFBW and PL. The IOF-treated poults had leg shanks significantly more symmetric than the controls (RA of 0.90 vs. 2.13, $p<0.01$), indicating better skeletal development. The IOF-treated hatchlings also had a significantly higher average poult quality score than the control poults (63.0 vs. 77.88, $p<0.05$). Even though the IOF poults may not always positively affect body weight at hatch, improved poult quality score and relative asymmetry indicate that IOF will likely improve the chances of post-hatch survival.

Key Words: In ovo Feeding, Poult Quality, Relative Asymmetry

T241 Bioavailability of zinc-amino acid chelates to zinc nitrate in broiler chickens. S. O. Rao*[1], S. J. Park[1], R. A. Samford[2], and S. W. Kim[1], [1]*Texas Tech University*, *Lubbock*, [2]*Albion Advanced Nutrition*, *Clearfield, TX*.

Relative bioavailability of zinc-glycine chelate I (26.2% Zn, Albion Advanced Nutrition), zinc-glycine chelate II (22.3% Zn, Albion Advanced Nutrition), and zinc-arginine chelate (12.8% Zn, Albion Advanced Nutrition) to zinc nitrate (24.3% Zn) was determined using 447, 1 d old, broiler chickens. Fifteen birds were killed at d 0 and ground for carcass sampling. Remaining 432 birds were allotted to four dietary treatments: CON (with 40 ppm Zn from Zn nitrate), TA (with 40 ppm Zn from Zn-glycine I), TB (with 40 ppm Zn from Zn-glycine II), and TC (with 40 ppm Zn from Zn-arginine). There were six replicates per treatment with initially 18 birds per stainless steel brooder cage with the heater. Birds had feed and water ad libitum during 21 d feeding period. Body weight and feed intake were measured on d 1, 3, 5, 7, 14, and 21. Groups of three birds were randomly selected and killed at d 1, 3, 5, 7, 14, and 21, ground together for each day, sampled, and analyzed for Zn. The ADG of birds were 32.0, 35.6, 35.6, and 35.9 g for CON, TA, TB, and TC respectively during the entire 3 wk period. The ADFI of birds were 42.6, 46.2, 45.7, and 46.1 g for CON, TA, TB, and TC respectively during the entire 3 wk period. However, ADG and ADFI were not different among the treatments. Content of Zn (mg/bird) in bird carcass was the same among the treatments until d 5. However, Zn content was greater ($P < 0.05$) in TA (3.08 mg) than CON (1.89 mg) at d 7 but Zn content was greater ($P < 0.05$) in TC (19.12 mg) than other treatments (13.24, 13.42, and 14.28 for CON, TA, and TB, respectively) by the end of 21 d feeding period. This study indicates that Zn from Zn-arginine is more bioavailable than Zn from inorganic source by broiler chickens during the first 3 wk of their age.

Key Words: Zinc Amino Acid Chelate, Broilers, Bioavailability

T242 The interactive effects of wheat middlings, citric acid, and phytase in a corn soybean meal diet on broiler growth performance. T. O'Connor-Dennie* and J. L. Emmert, *University of Arkansas*, *Fayetteville*.

Previous research conducted during the broiler starter, grower and finisher phases suggested that there was an interaction among wheat middlings (WM), citric acid (CA) and phytase when supplemented to corn soybean diets; combining all three supplements released more P than any supplement alone. In the present experiment the interactive effects among WM, CA, and phytase on daily gain (g/c), daily feed intake (g/c), feed efficiency, adjusted bone strength (kg/mm2), and bone ash percentage was investigated in the grower phase. Broilers were placed on a P-adequate diet from d 0 to 20; on d 20 birds were weighed and allotted to 15 treatments with 5 replicate pens each containing 20 male chicks. The dietary treatments were 1) a corn soybean diet with calculated levels of 0.8% Ca and 0.13 % available P with no supplemental inorganic P (iP), 2) as diet 1 with 0.04% iP, 3) as diet 1 with 0.08% iP, 4) as diet 1 with 0.12% iP, diets 5 to 15) as diet 1 with phytase (300 or 600 FTU/kg), CA (3%), or WM (10%), alone or in combination. At the end of the grower phase 5 birds per pen were killed by carbon dioxide inhalation and right tibias collected for subsequent determination of bone strength and ash analysis. The inclusion of supplemental iP increased gain ($P < 0.05$) and had a tendency to increase feed efficiency. Overall, inclusion of phytase and WM increased gain and feed efficiency, whereas the inclusion of CA only increased feed efficiency ($P < 0.05$). Combining phytase with WM or WM and CA increased gain and feed efficiency compared to diets 1 and 4, or to any supplement alone ($P < 0.05$), and combining all three supplements resulted in the best feed efficiency ($P < 0.05$). Combining WM and CA resulted in gain values greater ($P < 0.05$) than the negative control and equal to diets containing phytase. Results from this experiment confirm the additive effects of phytase with WM and CA, and the combination of all supplements appears to increase P utilization beyond the amount released by the supplements alone.

Key Words: Phytase, Citric Acid, Wheat Middlings

T243 Performance of modern vs 1970's heritage broilers fed drug free recommended and low protein diets. T. A. Woyengo*[1], A. Golian[2], W. Guenter[1], C. Bennett[3], and H. Muc[1], [1]*University of Manitoba*, *Winnipeg, Manitoba, Canada*, [2]*University of Ferdowsi*, *Mashhad, Iran*, [3]*Manitoba Agriculture, Food and Rural Initiative*, *Winnipeg, Manitoba, Canada*.

A study was conducted to compare the performance of a modern broiler breed (Ross; RS) with those of two 1970's heritage broiler breeds (HB1 and HB2) fed drug free recommended protein (RP; 22% CP) and low protein (LP; 19% CP) diets from 1 to 63 d of age. Six hundred mixed sex d old chicks from each of the three breeds were divided into ten groups of equal weight and randomly placed in 30 floor pens. Five replicates pens of each breed were randomly assigned to the RP and LP starter (1-16 d of age) and grower (16-30 d of age) diets, respectively. The LP grower diet was used to feed all birds from 31-63 d of age. The BW gain (BWG) and feed intake (FI) of the RS birds were higher ($P < 0.05$) than those of the two heritage breeds at 16, 30, 35, 49 and 63 d of age. Among the heritage breeds, the BWG and FI of HB1 birds were higher ($P < 0.05$) than those of HB2 birds at all the measured periods. For the entire experimental period, the BWG and FI of RS birds were higher than those of HB1 and HB2 birds by 35.6 and 53.4%, and 21.7 and 37.5%, respectively. The feed conversion ratio (FCR) was also better ($P < 0.05$) for RS birds than for HB1 and HB2 birds. The HB1 and HB2 birds were, however, similar ($P > 0.05$) in FCR. The BWG and FCR of all the three breeds were depressed ($P < 0.05$) when they were fed LP starter and grower diets up to 30 d of age, but not ($P > 0.05$) when they were fed a common finisher diet from 30 to 63 d of age. Regarding FI, a significant depression ($P < 0.05$) of a LP diet on the same was only observed for RS birds from 1 to 35 d of age. For the entire experimental period, the LP starter and grower diets only negatively affected BWG of the RS birds (3992 vs 3771 g/bird). The results show that the modern RS broilers compared with the 1970's heritage breeds have superior performance, but are more sensitive to dietary protein level.

Key Words: Broiler, Breed, Performance

Physiology & Endocrinology - Livestock and Poultry: Estrus Synchronization

T244 Evaluation of 5-day versus 7- day CIDR treatment on reproductive performance of beef cows using a timed AI protocol. D. Gunn*[1], J. B. Glaze, Jr.[2], R. Findlay[3], D. Falk[4], and A. Ahmadzadeh[4], [1]*University of Idaho Extension*, *Fort Hall*, [2]*University of Idaho*, *Twin Falls*, [3]*University of Idaho Extension*, *Pocatello*, [4]*University of Idaho*, *Moscow*.

The objective of this experiment was to determine the effect of reducing the length of CIDR exposure in a CIDR-based timed AI synchronization protocol (CIDR-$PGF_{2\alpha}$-GnRH and AI) on conception and pregnancy rates in multiparous, suckled beef cows. British cross-bred cows (n = 138) were stratified by days postpartum (**dpp**), age and body weight (**BW**) and were randomly assigned to one of the following two treatments: 1) cows (n = 68) received CIDR (d -7) for 7 days, $PGF_{2\alpha}$ (25 mg) at CIDR removal (d 0), GnRH (75 µ) 56 h after CIDR removal and immediate AI (d 3; **7-d CPG**); or 2) cows (n = 70) received CIDR (d -5) for 5 days, $PGF_{2\alpha}$ (25 mg) at CIDR removal (d 0), GnRH (75 µ) 56 h after CIDR removal and immediate AI (d 3; **5-d CPG**). Cows were exposed to bulls 19 days after timed-AI. Pregnancy status was determined by ultrasonography 35 and 68 days after AI. Treatment had no effect on conception to AI (54.41% and 55.71% for 7-d CPG and 5-d CPG, respectively). Pregnancy rate was also unaffected by the treatment protocols (79.41% and 77.14%) for 7-d CPG and 5-d CPG, respectively). Age, BW, and BCS did not have an effect on conception percentage and pregnancy rate. However, dpp had a significant effect ($P < 0.01$) on conception to AI (30% for < 60 dpp vs 80% for >60 dpp) and overall pregnancy rate (50% for < 60 dpp vs. 82% for >60 dpp). Results from this study indicate that reducing the length of CIDR treatment (5 days vs. 7 days) in a CIDR-based timed AI synchronization protocol did not influence conception to AI and pregnancy rate in suckled beef cows.

Key Words: Cattle, CIDR, Timed AI

T245 Effect of reusing CIDRs on the pregnancy rate of beef cattle. M. L. Borger* and W. A. Greene, *The Ohio State University*, *Wooster*.

The main objective of this study was to determine the effect of reusing CIDRs, as a part of a synchronization program, on pregnancy rates (PR) in beef cattle. One hundred-fourteen animals were allotted to two similar groups, new CIDR (N) and used CIDR (U), based upon breed, age, postpartum interval, and postpartum cyclicity (as determined by ultrasonography). All cattle received 100 µg GnRH i.m. on d 0. Also on d 0, cattle in the N group received a new intravaginal releasing device (CIDR), containing 1.38 g progesterone, while U group cattle received a CIDR previously used for 7 d. On d 7, jugular blood samples were collected for plasma progesterone (P4) analyses, CIDRs were removed, and all animals received 25 mg $PGF_{2\alpha}$ i.m. Each removed CIDR was evaluated for signs of vaginal infection and scored from 1 to 5 (1= clear, 5=heavy pus). Animals were observed for estrus 0700 and 1900 and were artificially inseminated (AI) 11-13 h after estrus was observed. If estrus was not observed, animals were timed AI (TAI) and received 100 µg GnRH i.m. 70-72 h after $PGF_{2\alpha}$. Following the synchronization period, repeat breedings were done until d 61. Cows were pregnancy diagnosed by ultrasonography on d 88. N and U groups had similar (P>.05) estrus detection rates [EDR] (47.4 and 59.7%), PR to synchronization (52.6 and 57.9%) and overall PR (86.0 and 93.0%). Cycling (n=91) and anestrous animals had similar (P> .05) EDR (55.0 and 47.8%), PR to synchronization (58.2 and 43.5%), and overall PR (89.0 and 91.3%). Cattle with high vaginal scores (4 & 5, n= 76) and low vaginal scores (1, 2, and 3) had similar (P> .05) PR to synchronization (55.3 and 55.3%) and overall PR (85.5 and 97.4%). The N group had more (P< .05) high vaginal scores than the U group (77.2 and 56.1%). Mean P4 levels (ng/ml) were similar (P> .05) for N (1.9 ± 1.2) and U (1.9 ± 1.4) cattle. P4 levels were higher (P< .05) at CIDR removal for cycling (2.0 ± 1.3) than anestrous (1.4 ± 1.0) cattle. There were no noticeable differences between synchronizing beef cattle with previously used CIDRs and new CIDRs.

Key Words: Synchronization, CIDR Reuse, Progesterone

T246 Evaluation of human chorionic gonadotropin (hCG) as a replacement for GnRH in an ovulation-synchronization protocol before fixed timed AI. M. G. Burns*[1], B. S. Buttrey[1], D. R. Eborn[1], J. E. Larson[2], B. J. Lovaas[2], G. C. Lamb[2], K. C. Olson[1], and J. S. Stevenson[1], [1]*Kansas State University*, *Manhattan*, [2]*University of Minnesota*, *Grand Rapids*.

Two experiments evaluated differences between GnRH and hCG given at the onset of a timed AI protocol and their effects on fertility. In Exp. 1, beef cows (n = 676) at 6 locations were assigned randomly to treatments based on parity, BCS, and days postpartum. On d –20 and –10, blood was collected to determine progesterone (P4) concentrations and assess cyclicity. Blood was collected for P4 analysis at each subsequent handling of 113 cows at 1 location. Cattle were treated with a CIDR insert on d –10 and with 100 μg of GnRH (OvaCyst) or 1,000 IU of hCG (Chorulon; CO-Synch + CIDR). An injection of PGF2α (Prostamate) was given and CIDR inserts were removed on d –3. Cows were inseminated at 62 h (d 0) after CIDR insert removal. Pregnancy was diagnosed at 33 d (range: 32 to 35 d) after AI to determine pregnancy rate (PR). For cows that were pregnant after the first AI, a second pregnancy diagnosis was conducted 35 d (range: 33 to 37 d) after the first diagnosis to determine pregnancy survival. Injection of hCG reduced ($P < 0.001$) PR compared with GnRH, with a greater reduction in noncycling cows. Serum P4 was greater ($P = 0.06$) 7 d after hCG than after GnRH (4.4 ± 0.5 vs 3.2 ± 0.5 ng/mL). In Exp. 2, cattle were assigned randomly to 3 treatments, balanced across the 2 treatments applied in Exp. 1. Cows were injected (same doses as in Exp. 1) with GnRH, hCG, or saline 7 d before first pregnancy diagnosis in Exp. 1. At the time of pregnancy diagnosis, cattle diagnosed not pregnant (n = 328) were given PGF2α and inseminated 56 h later, concurrent with a GnRH injection. Compared with saline (n = 107), injections of GnRH (n = 107) and hCG (n = 114) tended ($P = 0.07$) to reduce PR at second AI (40, 33, and 31%), respectively. Concentrations of P4 did not differ among GnRH, hCG, or saline cows (6.0 ± 0.6, 6.6 ± 0.6, 6.4 ± 0.5 ng/mL, respectively) 7 d after treatment at pregnancy diagnosis. We concluded that hCG compared with GnRH given before first timed AI reduced PR (Exp. 1). Neither GnRH nor hCG may be necessary to initiate a CO-Synch protocol for cows identified not pregnant at 33 d after AI (Exp. 2).

Table 1. Pregnancy rates (PR) and pregnancy survival (PS) after first timed AI

Exp. 1	Exp. 2	PR at first AI, % (no.)	PS 33 to 68 d, % (no.)	PR After 2 AI, % (no.)
	Sal	54.5 (112)	90.2 (61)	67.9 (112)
GnRH	GnRH	55.2 (116)	92.2 (64)	64.3 (115)
	hCG	50.5 (111)	96.4 (56)	65.1 (109)
GnRH Σ		53.4[a] (339)	92.8 (181)	65.8 (336)
	Sal	38.4 (112)	93.0 (43)	62.7 (110)
hCG	GnRH	38.3 (107)	97.6 (41)	61.7 (107)
	hCG	39.8 (118)	95.7 (46)	56.8 (118)
hCG Σ		38.9 (337)	95.4 (130)	60.3 (335)

[a]Different ($P < 0.001$) from hCG total.

Key Words: Ovulation Synchronization, hCG, GnRH

T247 Synchronization of estrous with melengestrol acetate and estradiol cypionate in Nellore heifers and Angus dry cows. R. F. G. Peres*[1], O. G. Sa Filho[1], R. L. Valarelli[2], and J. L. M. Vasconcelos[1], [1]*FMVZ - UNESP*, *Botucatu, Brazil*, [2]*Pfizer Animal Health*, *Brazil*.

Two experiments evaluated reproductive performance of Angus dry cows and Nellore heifers treated with melengestrol acetate (MGA; MGA Premix®, Pfizer Animal Health, Brazil) associated to estradiol cypionate (ECP®, Pfizer Animal Health, Brazil). Exp.1 evaluated estrus detection (EDR), conception (CR) and pregnancy rates (PR) in a 10 days breeding season (BS) in Angus dry cows treated with melengestrol acetate. Exp.2 evaluated EDR, CR and PR in the first 10 days of BS and PR in 30 days of BS in Nelore heifers. In both experiments, animals were randomly assigned to receive one of two treatments: Control (no treatments; Exp.1: n=60; Exp.2: n=180) or MGA+ECP (addition of MGA on mineral between days -14 and -1, and 2.0mg i.m. injection of ECP on day -9; Exp.1: n=67; Exp.2: n=321). Estrus behavior observation started on day 0 and cows detected in heat were inseminated after 12h. Data were analyzed by Chi-square. In Exp.1, treatment with MGA+ECP increased EDR (62.7% vs. 36.7%; P<0.01) and tended to increase PR (37.3% vs. 21.7%; P<0.1). The effect of MGA+ECP treatment on PR was mainly due to increase on EDR since no effect on CR was found (59.1% vs. 59.5% for Control and MGA+ECP treatments, respectively). In Exp.2, treatment with MGA+ECP increased EDR (64.2% vs. 30.6%; P<0.0001) and PR in the first 10 days of BS (29.3% vs. 15.0%; P<0.001). The effect of MGA+ECP treatment on PR was mainly due to increase on EDR since no effect on CR was found (49.1% vs. 45.6% for Control and MGA+ECP treatments, respectively). PR in 30 days of BS was higher in heifers treated with MGA+ECP than in Control (55.4% vs. 35.6%; P<0.0001). In conclusion, treatment with MGA+ECP did not alter CR, but increased EDR and PR, allowing higher amount of cattle pregnant in shorter time.

Key Words: MGA, Dry Cows, Heifers

T248 Effect of treatment with melengestrol acetate combined with estradiol cypionate on pregnancy rates along a 70 days breeding season in postpartum Nellore cows. R. F. G. Peres*[1], O. G. Sa Filho[1], R. L. Valarelli[2], and J. L. M. Vasconcelos[1], [1]*FMVZ - UNESP*, *Botucatu, Brazil*, [2]*Pfizer Animal Health*, *Brazil*.

The aim of this trial was to evaluate the effect of treatment with melengestrol acetate (MGA; MGA Premix®, Pfizer Animal Health, Brazil) associated with estradiol cypionate (ECP®, Pfizer Animal Health, Brazil) on pregnancy rates (PR) to natural service of postpartum Nellore cows at 10, 40 and 70 days of breeding season (BS). Postpartum Nellore cows (n=204) were randomly assigned to receive one of two treatments: Control (no treatment; n=102) or MGA+ECP (addition of MGA on mineral between days -14 and -1, and 2.0mg i.m. injection of ECP on day -9; n=102). On day 0, cows from MGA+ECP treatment received calf removal and cows from both two treatment groups were allocated with sires (1/15 proportion) for natural service during 70 days. Pregnancy diagnosis were performed by ultrasound on days 40, 70 and 100 of BS to determine PR at 10, 40 and 70 days of BS. Data were analyzed by Chi-square. Treatment with MGA+ECP increased PR at 10 days (12.7% vs. 4.9%; P<0.05) and at 70 days (55.45% vs.

35.6%; P<0.01), and tended to increase PR at 40 days of BS. (47.1% vs. 35.3%; P<0.1). In summary, treatment with MGA+ECP resulted in a higher proportion of cows pregnant during the BS.

Key Words: MGA, ECP, Natural Service

T249 Effect of estradiol cypionate dosage (1 vs. 2 mg) on estrus detection and pregnancy rates of postpartum Nellore cows synchronized with melengestrol acetate. R. L. Valarelli*[1], O. G. Sa Filho[2], and J. L. M. Vasconcelos[2], [1]*Pfizer Animal Health*, *Brazil*, [2]*FMVZ - UNESP*, *Botucatu, Brazil*.

The aim of this trial was to evaluate the effect of two dosages of estradiol cypionate (ECP®, Pfizer Animal Health, Brazil) on estrus detection (EDR) and pregnancy rates (PR) of postpartum Nellore cows synchronized with melengestrol acetate(MGA; MGA Premix®, Pfizer Animal Health, Brazil). Postpartum multiparous Nellore cows (n=399), evaluated on day -14 by ultrasound to determine presence of corpus luteum (CL), were randomly assigned to receive one of three treatments: Control (no treatment; n=127), ECP1 (addition of MGA on mineral between days -14 and -1, and 1.0 mg of ECP on day -9; n=137) or ECP2 (addition of MGA on mineral between days -14 and -1, and 2.0 mg of ECP on day -9; n=135). On day 0, cows from ECP1 and ECP2 treatments received calf removal and cows from the three treatment groups were observed for estrus behavior during 30 days. Cows were inseminated 12h after heat detection. Data were analyzed by logistic regression, and when effect of treatment was detected, means were compared by orthogonal contrasts (C1: "MGA1" vs. "MGA2"; C2: "Control" vs. "MGA1" + "MGA2"). There was effect of treatment on EDR (Control: 14.9%; ECP1: 48.2%; ECP2: 47.4%; C1: P>0.1; C2: P<0.001) and PR (Control: 7.9%; ECP1: 21.2%; ECP2: 21.5%; C1: P>0.1; C2: P<0.01) in the first 10 days of breeding season (BS). Effect of treatments on PR in the first 10 days of BS was mainly due to increase on EDR, since no effect of treatments on conception was detected. Treatments tended to affect PR in 30 days of BS (Control: 30.7%; ECP1: 31.4%; ECP2: 42.2%; C1: P<0.1; C2: P>0.1). Considering only cows treated with MGA, presence of CL did not affect EDR (47.8%), conception (44.6%) and PR (25.0%) in the first 10 days of BS, and on PR in 30 days of BS (36.8%). In conclusion, regardless of ECP dosage, treatment with MGA+ECP brought heat behavior together in the first 10 days of BS, anticipating conception, and allowed cows without presence of CL to have similar PR than cows with CL.

Key Words: MGA, ECP, Pregnancy Rate

T250 Pregnancy rates in a 10 days breeding season in postpartum Nellore cows treated with melengestrol acetate associated or not with estradiol cypionate. R. L. Valarelli*[1], O. G. Sa Filho[2], M. Meneghetti[2], and J. L. M. Vasconcelos[2], [1]*Pfizer Animal Health*, *Brazil*, [2]*FMVZ - UNESP*, *Botucatu, Brazil*.

The aim of this trial was to evaluate the effect treatment with melengestrol acetate (MGA; .5mg/head/day; MGA Premix®, Pfizer Animal Health, Brazil) associated or not with estradiol cypionate (ECP®, Pfizer Animal Health, Brazil) on pregnancy rate (PR) to natural service of postpartum Nellore cows during a 10 days breeding season (BS). Postpartum Nellore cows (n=1033) were blocked according to presence of corpus luteum (CL; evaluated on day -14 by ultrasound). Within each block, cows were randomly assigned to receive one of three treatments: Control (no addition of MGA; n=67 with CL; n=245 without CL), MGA (addition of MGA between days -14 and -1; n=93 with CL; n=278 without CL) or MGA+ECP (addition of MGA between days -14 and -1, and 2.0mg i.m. injection of ECP on day -9; n=86 with CL; n=265 without CL). On day 0, cows from MGA and MGA+ECP treatments received calf removal and cows from the three treatment groups were allocated with sires (1/15 proportion) for natural service during 10 days. Data were analyzed by logistic regression, and when effect of treatment was detected, means were compared by orthogonal contrasts (C1: "MGA" vs. "MGA+ECP"; C2: "Control" vs. "MGA" + "MGA+ECP"). Treatments affected PR in cows without CL (Control: 12.6%; MGA: 36.3%; MGA+ECP: 38.5%; C1: P>0.1; C2: P<0.001). In cows with CL, treatments affected PR (Control: 40.3%; MGA: 36.6%; MGA+ECP: 54.6%; C1: P<0.05; C2: P>0.1). Beneficial effect of ECP in cows with CL could be due to prevention of development of persistent dominant follicle. Regardless of treatment, body condition score (BCS) affected PR in cows without CL (P<0.0001) but not in cows with CL, indicating that the effect of BCS is mainly in resuming of cyclicity than in conception. In conclusion, in cows without CL, treatment with MGA (associated or not with ECP) increased amount of cows pregnant in a 10 days BS; in cows with CL, treatment with MGA should be associated with ECP for better PR.

Key Words: MGA, ECP, Natural Service

T251 Fixed-time artificial insemination in replacement beef heifers after treatment with human chorionic gonadotropin (hCG), progesterone, and prostaglandin $F_{2\alpha}$. G. C. Lamb[1], J. E. Larson*[1], C. R. Dahlen[2], and G. Marquezini[1], [1]*North Central Research and Outreach Center, University of Minnesota*, *Grand Rapids*, [2]*Northwest Research and Outreach Center*, *Crookston, MN*.

We determined whether pre-treatment with human chorionic gonadotropin (hCG) 14 d prior to estrous synchronization or replacing GnRH with hCG at the time of CIDR insertion would alter pregnancy rates in replacement beef heifers estrous synchronized with the CO-Synch + CIDR protocol. Five hundred forty seven replacement beef heifers were assigned randomly to one of four treatments in a 2 × 2 factorial design: 1) heifers received a 100 µg injection of GnRH at CIDR insertion (d -7) and a 25 mg injection of $PGF_{2\alpha}$ at CIDR removal (d 0), followed in 54 h by fixed-time AI (TAI) with a second injection of GnRH (CG; n=160); 2) CG but the first injection of GnRH was replaced with a 1,000 IU injection of hCG (CH; n=158); 3) CG, plus heifers received a 1,000 IU injection of hCG 14 d prior to CIDR insertion (HG; n=116); and 4) CH, plus heifers received a 1,000 IU injection of hCG 14 d prior to CIDR insertion (HH; n=113). Blood samples were collected on d -24, -14, -7, 0, and 2 to determine concentrations of progesterone. Transrectal ultrasonography was used to monitor ovarian structures on d -7 and 0, plus pregnancy status on d 35. Between pre-treatment factors of control or hCG pregnancy rates were similar, whereas for the factor of GnRH or hCG at CIDR insertion pregnancy rates for the GnRH treated heifers (41%) was greater (P < 0.05) than hCG treated heifers (29%). Heifers treated with hCG at CIDR insertion had an increased (P < 0.05) occurrence of multiple corpora lutea compared to those receiving GnRH at the time of CIDR removal (38.3% vs. 24.0%, respectively) and had increased concentrations of progesterone at the time of CIDR removal (2.68 ng/ml vs 2.10 ng/ml; P < 0.05) and at TAI (0.56 ng/ml vs. 0.39 ng/ml; P < 0.05). We concluded that presynchronization with hCG 14 d prior

to CIDR insertion failed to enhance pregnancy rates and replacing GnRH at CIDR insertion with hCG resulted in decreased pregnancy rates. However, hCG enhanced the incidence of multiple ovulations and concentrations of progesterone at CIDR removal and at TAI.

Key Words: Human Chorionic Gonadotropin, Estrous Synchronization, Beef Heifers

T252 Artificial insemination of superovulated Angus cows using sexed or conventionally frozen semen. G. C. Lamb*[1], B. J. Lovaas[1], S. L. Bird[1], A. Martins[1], J. E. Larson[1], J. C. Rodgers[1], D. J. Frank[2], and D. M. Williams[2], [1]*North Central Research and Outreach Center, University of Minnesota*, *Grand Rapids*, [2]*ABS Global, Inc.*, *DeForest, WI*.

We determined whether embryo production characteristics would be compromised in a superstimulation protocol when sexed semen was utilized for insemination of donors. Thirty two, Angus cows from a single herd were stratified by age and body condition score before random assignment to a switch-back experimental design: 1) cows received four inseminations of conventionally frozen semen at a minimum concentration of 15×10^6 sperm/straw (Conventional; n = 32); and 2) cows received four inseminations of sexed semen at a minimum concentration of 2.1×10^6 sperm/straw (Sexed; n = 32). Cows were blocked by two separate AI sires. During period 1, 10 d after estrus, eight 2× daily injections of FSH were administered to the cows, with cows receiving PGF at the time of the seventh injection of FSH. Cows were inseminated 1× at the time of first detected estrus, 2× 12 h after onset of estrus, and 1× 24 h after onset of estrus. Embryos were collected 7 d after first detected estrus and all embryos were assigned a developmental stage and quality grade. After a 30 d adaptation interval, period 2 was initiated and cows were resynchronized and superovulated using the same protocol as for period 1. The total ova per flush was similar between Conventional (11.7 ± 1.8) and Sexed treatments (12.0 ± 1.6), but the number of transferable embryos was greater ($P < 0.01$) for Conventional (6.5 ± 1.0) than Sexed (4.5 ± 0.9) treatments. In contrast, the mean number of unfertilized ova were greater ($P < 0.05$) for Sexed (6.3 ± 1.0) than Conventional (3.1 ± 1.2) treated cows. The number of degenerate, Grade 2, and Grade 3 embryos were similar among treatments. There were no differences between Bull 1 (44.4%) and Bull 2 (46.7%) in the percentage of transferable embryos recovered. However, fertilization rates and the percentage of transferable embryos where affected ($P < 0.05$) by period and donor. We concluded that insemination of superstimulated donor cows with sexed semen will result in lower transferable embryos and an increase in unfertilized ova than those cows inseminated with conventionally frozen semen.

Key Words: Superovulation, Sexed Semen, Artificial Insemination

T253 Effect of length of treatment with melengestrol acetate (7 vs. 13 days) prior to induction of ovulation on occurrence of short cycle in anestrous Nellore cows. O. G. Sa Filho*[1], R. L. Valarelli[2], and J. L. M. Vasconcelos[1], [1]*FMVZ - UNESP*, *Botucatu, Brazil*, [2]*Pfizer Animal Health*, *Brazil*.

The aim of this trial was to evaluate if treatments with 1.5 mg/day of melengestrol acetate (MGA; MGA Premix®, Pfizer Animal Health, Brazil) during 7 or 13 days prior to induction of ovulation are effective to prevent premature luteolysis in anestrous Nellore cows. Fifty three post-partum anestrous multiparous Nellore cows (evaluated by two ultrasound exams 9 days apart) were randomly assigned to receive one of three treatments: Control (no addition of MGA on mineral; n = 15), MGA-7 (addition of MGA on mineral between days -10 and -3; n=18) or MGA-13 (addition of MGA on mineral between days -16 and -3; n = 20). Ovulation was induced with 48 h calf removal (between days -2 and 0) followed by 100 mcg i.m. GnRH (Fertagyl®, Intervet, Brazil) injection on day 0. Ovarian ultrasound exams were performed to measure size of ovulatory follicle (day 0) and to evaluate ovulation (days 0 and 2). Cows that did not ovulate were excluded from the trial (n = 13). On day 9, ultrasound exam was conducted aiming to determine presence and size of CL, and blood samples were collected for serum progesterone analysis by RIA. Cows were considered having short cycle when luteal tissue was absent and/or serum progesterone was <0.5 ng/mL. Binomially distributed data and continuous data were analyzed by PROC LOGISTIC and PROC GLM of SAS, respectively. Treatments did not affect ovulation rate (Control: 86.7%; MGA-7: 72.2%; MGA-13: 75.0%; P>0.1), but affected size of ovulatory follicle (Control: 9.8±0.4 mm; MGA-7: 10.6±0.4 mm; MGA-13: 11.9±0.4 mm; P<0.01) and percentage of short cycle (Control: 76.9%; MGA-7: 38.5%; MGA-13: 0.0%; P<0.001). In conclusion, feeding anestrous cows with 1.5mg/day of MGA during 13 days decreased percentage of cows with premature luteolysis following the first postpartum ovulation.

Key Words: Melengestrol Acetate, Anestrous Cows, Short Cycle

T254 Effect of length of exposure to exogenous progesterone (3 vs. 6 days) prior to induction of ovulation on premature luteolysis in anestrous Nellore cows. O. G. Sá Filho*, C. R. Zilioti, and J. L. M. Vasconcelos, *FMVZ - UNESP*, *Botucatu, Brazil*.

The objective of this trial was to evaluate if 3 days pre-treatment with exogenous P_4 has the same efficiency than 6 days pre-treatment on prevention of short cycles. Anestrous Nellore cows (evaluated by 2 ultrasound exams 8 days apart; n=109) were randomly divided in two experimental groups: 3d Group - Intravaginal P_4 device (CIDR®, Pfizer Animal Health, Brazil) by 3 days followed by calf removal (CR; 48 hours); Control Group: Intravaginal P_4 device by 6 days followed by CR. At end of CR (day 0), all cows received 100mcg GnRH i.m. injection GnRH (Fertagyl®, Intervet, Brazil). Ovulation was evaluated by two ultrasound exams on days 0 and 2 and only cows which ovulate were used for the study (Control: n=36; Group 3d: n=18). Blood samples were collected on days 0, 5, 7 and 9 for corpus luteum lifespan evaluation by serum P_4 dosage (RIA). Ovulation rate and percentage of short cycles were analyzed by logistic regression and serum P_4 concentrations were analyzed by PROC MIXED of SAS. Ovulation rate was lower (P<0.001) on 3d Group (33.3%, 18/54) than Control (65.4%, 36/55). The frequency of short cycles did not differ among both groups (5.5% vs. 5.5%, P>0.10), as well as serum P_4 concentrations on days 0, 5, 7 and 9 (0.3±0.5 vs. 0.3±0.4; 1.8±0.5 vs. 2.1±0.4; 2.8±0.5 vs. 2.9±0.4; 3.4±0.5 vs. 3.6±0.4 ng/mL respectively; P>0.10). For both treatments, serum P_4 increased between days 0, 5, 7 and 9 (P<0.001), indicating normal development of CL during this period. We concluded that 3 days treatment with P_4 prior to induction of ovulation in anestrous cows warranted normal luteal lifespan.

Key Words: Progesterone, Anestrous Cows, Short Cycle

T255 Ovarian and hormonal responses to a progesterone releasing intravaginal device (PRID) treatment in the presence or absence of estradiol from the early luteal phase in heifers. T. Kuroiwa*, T. Tanaka, and H. Kamomae, *Tokyo University of Agriculture and Technology*, *Fuchu, Tokyo, Japan*.

Some studies have reported that the timing of a progesterone device treatment in the estrous cycle influences the efficacy of estrus synchronization. The aim of this study was to investigate ovarian and hormonal profiles in heifers treated with a PRID with or without 10mg of estradiol benzoate (E) from the early luteal phase. Cycling Holstein heifers were assigned randomly to five groups and received PRID with E (PE0; n=6) or without E (P0; n=5) on Day 0 (= ovulation), or PRID with E (PE2; n=6) or without E (P2; n=6) on Day 2, for 12 days. The control group received a placebo device from Day 0 to Day 14 (Cont; n=5). Ultrasonographic images of the ovary and blood samples were collected throughout the experiment. The proportions of heifers with detected estrus within three days after PRID removal in the PE0, P0, PE2, P2, and Cont groups were 3/6, 2/5, 3/6, 2/6, and 0/5, respectively. There was no significant difference in the mean plasma concentrations of progesterone among the five groups during the period of PRID treatment except for a few days after PRID insertion. The mean area of corpus luteum (CL) in four PRID treated groups was significantly smaller than that in the Cont group ($p<0.05$). CL regression started on Days 10.6±4.4, 10.8±5.4, 14.3±0.5, 13.8±5.6 and 16.8±0.8 in the PE0, P0, PE2, P2 and Cont groups, respectively, and there was a significant difference between PE0 and PE2 ($p<0.05$). In the most heifers that did not exhibit the estrus within three days, no developing dominant follicle was observed at PRID removal. These data suggest that earlier treatment of PRID with E after ovulation advances the regression of CL during the early luteal phase; however, the effective rate for estrus synchronization was around 50 % in all groups. The mechanism for the failure of estrus synchronization seems to be correlated to the absence of growing follicle at the time of PRID removal rather than the regression of CL in the case of PRID treatment from the early luteal phase.

Key Words: Estrus Synchronization, Early Luteal Phase, PRID

T256 A stochastic model to compare breeding system costs for synchronization of estrus and AI to natural service. S.K. Johnson* and R.D. Jones, *Kansas State University*, *Manhattan*.

A partial budget approach was used to stochastically model costs of several systems for synchronization of estrus and AI plus clean-up natural service compared to natural service only breeding systems and to identify the most important factors in determining the differences in the expected economic returns between breeding systems. Three herd sizes, 3 cow to bull ratios and 7 systems for synchronization of estrus were examined, for a total of 63 simulation models. Each model estimated the expected distribution of costs associated with one synchronization system and compared it to the natural service option. Stochastic variables in the model included bull purchase price, percent calf crop, calf price, AI conception rate, cull bull value, cull bull weight, genetic value premium of AI-sired calf, heat detection rate, season pregnancy rate, semen cost, and synchronized calf weight advantage. Cost per pregnancy for breeding systems that included both AI and natural service ranged from $46 to $95. Natural service tended to be a lower cost breeding system at higher cow to bull ratios whereas AI systems were more cost effective at lower cow to bull ratios. Overall, the combination heat detection and clean-up fixed-time AI synchronization systems were economically preferred to natural service 33% of the time, with this value increasing to 41% for synchronization systems using strict fixed-time AI, and 49% for heat detection only systems. Heat detection only systems in large herds using low cow to bull ratios demonstrated a net economic advantage relative to natural service 85% of the time. Genetic value premiums and semen cost were consistently included in the top 3 factors that determined expected economic differences between natural service and AI systems across herd sizes and cow to bull ratios. Variability in bull purchase price was the most important factor when the cow to bull ratio was low. Estrus synchronization and AI were economically advantageous when a sufficient genetic value premium could be obtained from AI-sired calves.

Key Words: Estrus Synchronization, AI, Breeding Costs

T257 Different estrus syncryonization protocols in sheep. B. R. Avila[1], M. T. Sánchez[1], E. O. García*[2], O. D. Montañez-Valdez[3], P. M Molina[1], J. G. Peralta[1], M. E. Ortega[1], and J. L. Cordero[1], [1]*Colegio de Postgraduados*, *Montecillo, Estado de México, México*, [2]*Centro Universitario de la Costa Sur de la Universidad de Guadalajara*, *Aútlan, Jalisco, México*, [3]*Centro Universitario del Sur de la Universidad de Guadalajara*, *Ciudad Guzmán, Jalisco, México*.

The objective of the present experiment was to evaluate different protocols for estrus synchronization in ewes. It was performed in a sheep farm located in the property ″El Tilzapote″, which is located north of the city of Autlán de Navarro, Jalisco, México. Forty adult female crossbreed Katahdin and Pelibuey with over 2 deliveries were used, which were randomly assigned to four treatments of ten ewes each. In treatment A, two dosages of 1 ml de synthetic $PGF_{2\alpha}$ (d-cloprostenol 0.075 mg/ml) were administered on days -22 and -13, and on day -11 a Chronogest intravaginal sponge containing 40 mg fluorgestone acetate (FGA) was inserted, on day 0 sponges were removed and 1 ml intramuscular $PGF_{2\alpha}$ was administered. Treatment B was similar to treatment A but sponges remained for 5 days. In treatment C, two dosages 1 ml $PGF_{2\alpha}$ were administered on day PGFs -24 and -15, on day -7, 50 µg (0.5 ml) of a synthetic GnRH was administered, and on day 0, 1 ml $PGF_{2\alpha}$ In treatment D, three applications of 1 ml $PGF_{2\alpha}$ were given, with 9 day intervals on days -18, -9 and 0. Estrus detection was performed 24 hours after the removal of the intravaginal sponge and the last dosage of $PGF_{2\alpha}$, ewes were observed during 1 h every 4 h, for a period of 4 days. Percentages of onset of estrus and gestation were analyzed with Xi^2 , and onset and duration of estrus with GLM procedure of SAS. The percentage of females detected in estrus were 100, 100, 90 and 80 % for treatments A, B, C, and D, respectively ($P>0.05$); the time to onset of estrus was at 42.8 ± 6.81, 55.20 ± 15.17, 43.55 ± 3.71 and 40 ± 8.28 h for treatments A, B, C, and D, respectively ($P<0.05$); the duration of estrus was 36 7.54, 28.4 ± 3.97, 35.1 ± 5.20 and 42.5 ± 13.68 h for treatments A, B, C, and D respectively ($P<0.05$); the percentage of gestation was of 60 % for treatment A, and 90 % for treatments B, C, and D ($P<0.05$). The estrus cycle of ewes can be synchronized with intravaginal sponges of FGA for 5 days, as well as with GnRH and prostaglandin with similar results of the traditional use of the sponge for 11 days.

Key Words: Estrus, Synchronization, Sheep

T258 Treatment with bST during progestin synchronization increases the blastocyst rate in ewes. A. Montero, J. Hernández, J. Valencia, C. G. Gutiérrez, S. Rojas, and J. Hernández-Cerón*, *Facultad de Medicina Veterinaria y Zootecnia. Universidad Nacional Autónoma de México.*, *Mexico*.

Treatment with bST during synchronization increased prolificacy in sheep. Here, we tested whether a single dose of bST 5 days before the end of progestin treatment improves fertilization and embryo development. Thirty-two ewes were synchronized with progestin and superovulated with FSH. Five days before the end of progestin treatment half of the ewes were injected with 125mg bST (n=16; Lactotropina®, Elanco) or saline solution (control; n=16). Estrus was detected every 2h and estrous sheep were served every 8 h whilst in estrus. Embryos were recovered on day 7 of the cycle. Embryos were assessed microscopically and fixed in 4% paraformaldehyde. Cell numbers in blastocysts were counted after Hoechst staining. In addition, blood samples were collected from 8 sheep per group, starting the day of bST treatment and ending on the day of embryo recovery to determine plasma concentration of IGF-I, insulin and progesterone. The proportions of cleaved and transferable embryos in the morula and blastocyst stage were compared between groups by logistic regression. Cell number, IGF-I, insulin and progesterone plasma concentrations was analyzed by ANOVA. Cleavage rate was greater (P<0.01) in the bST (86) than in the control group (62) whilst transferable embryos did not change (P>0.83; bST=88.5 vs control=87.5). However, the proportion of embryo reaching the blastocyst stage (bST =77.6 vs. control =48.5) and the number of cells in the blastocyst (bST =88.9±3.7 vs. control =76.1\plusmn;3.7) were greater (P<0.01) in bST treated sheep. Plasma concentrations of IGF-I and insulin were higher (P<0.01) in bST treated sheep. No changes were observed in progesterone concentrations (P>0.49). It is concluded that bST treatment is associated with increased IGF-I and insulin concentrations and that treatment during the period of follicular development, fertilization and early embryo development increases cleavage rate and blastocyst development in sheep.

Key Words: bST, Blastocyst, Sheep

T259 Effect of estradiol–17β supplementation at the last GnRH of the Ovsynch protocol in lactating dairy cows. A. P. Cunha*, J. N. Guenther, E. P. B. Silva, J. B. C. Heijink, and M. C. Wiltbank, *University of Wisconsin*, *Madison*.

The aim of this study was to evaluate whether estradiol supplementation at the last GnRH of the Ovsynch protocol would affect ovulation rate, uterine tone score, and pregnancies/AI (P/AI) in a TAI protocol for lactating dairy cows. Holstein cows (n=391) were assigned to two groups in a CRD design. Control cows were presynchronized (GnRH–7d–PGF2α–3d–GnRH) and 7d later began Ovsynch (GnRH–7d–PGF2α–52h–GnRH–18h–TAI). Treated cows received the same TAI protocol plus 0.5 mg of estradiol–17β (E2) at the second GnRH of Ovsynch. Ovarian ultrasound and uterine palpation were performed in order to assess ovulation, ovulatory follicle size, pregnancy diagnosis and uterine tone score. Ovulation rate differed between 1st and later services (P<0.05) but did not differ between E2–treated vs control cows at 1st service (91.4%, n=81 vs. 90.7%, n=75) and second or later services (76.6%, n=77 vs. 75.3%, n=81). Average ovulatory follicle size was not different between E2–treated and control (14.9 mm vs. 15.1 mm; P>0.10). There was an interaction between season and ovulatory follicle size. Cows ovulated smaller follicles during Aug–Sep when compared with Oct–Jan (average amb. temp.: Aug–Sep=61F; Oct–Jan=36F). E2–treated cows had higher uterine tone scores at TAI than control cows (2.53, n=113 vs. 2.35, n=119; P<0.05). Overall P/AI and pregnancy loss did not differ (P>0.10) between E2 and control; however, parity (P=0.04) and number of service (P=0.03) did have an effect on P/AI. Primiparous E2–treated cows had higher P/AI than multiparous E2–treated cows (53.1% vs 35.5%; P=0.03), and also tended to have better P/AI than primiparous (40.0%, P=0.07) and multiparous control (42.7%, P=0.10) cows. 1st service E2 cows had higher P/AI than later services, but there was no difference between 1st service E2 and 1st service control cows. In conclusion, E2 increased uterine tone, but did not have an overall effect on P/AI. Nevertheless, E2 supplementation at the last GnRH of Ovsynch may increase P/AI in primiparous cows at the first service postpartum.

Key Words: Estradiol, Uterine Tone, Dairy Cow

T260 Effect of GnRH after TAI on subsequent Resynch fertility. A. P. Cunha*, J. A. Powell, J. N. Guenther, E. P. B. Silva, and M. C. Wiltbank, *University of Wisconsin*, *Madison*.

Two experiments were performed to evaluate if GnRH treatment 15–16d after TAI increased pregnancies/AI (P/AI) during the subsequent Ovsynch–TAI in high producing dairy cows. In experiment 1, cows (n=368) were presynchronized (GnRH–7d–PGF–3d–GnRH) and 7d later began Ovsynch (GnRH–7d–PGF–52h–GnRH–18h–TAI).Cows were then assigned randomly but at a 2:1 distribution to one of two groups: 1) G–16 – received GnRH (100µg) 16d after last GnRH of Ovsynch; 2) control – no treatment. Ovarian ultrasound was used to assess ovulation and for pregnancy diagnosis. Macro GLIMMIX of SAS was used for statistical analyses. Ovulation to G–16 differed between open and pregnant cows (43.5% vs 22.4%; P<0.01; n=209). Ovulation to GnRH on day 26 (1st GnRH of Resynch) was higher for G–16 cows that ovulated to G–16 than those that did not (52.4% vs 34.7%; P=0.02; n=161), but there was no difference between G–16 and controls (44.1%, n=93). There was no effect of G–16 on P/AI to previous TAI (40.0% vs. 40.7%; n=368). However, cows that received G–16 had numerically higher P/AI at the subsequent TAI (33.0% vs 26.4%; P>0.10; n=144). In experiment 2, 781 lactating Holstein cows underwent Presynch (PGF–14d–PGF) and 14 days later began Ovsynch (GnRH–7d–PGF–48h–GnRH–16h–TAI). At 15d after last GnRH of Ovsynch cows were assigned to one of two groups: 1) G–15 – received GnRH 15d after last GnRH of Ovsynch; 2) control – no treatment. Cows in G–15 had similar P/AI as Control cows at previous AI (36.3% vs. 33.9%; n=781) but higher P/AI at subsequent AI (38.8% vs 23.7%; P=0.01; n=278). Parity (P<0.05) had an effect on P/AI at subsequent AI with G–15 higher than control in primiparous cows (47.9%, n=48 vs 27.8%, n=36; P=0.05) or multiparous cows in G–15 (31%, n=87; P=0.05) or control (22.2%, n=90; P<0.01). In conclusion, GnRH treatment at 15–16d after TAI increased P/AI at subsequent TAI in lactating dairy cows. The positive effect of post–breeding GnRH on subsequent TAI may depend on ovulation to the GnRH and may possibly improve synchrony for the subsequent Resynch protocol.

Key Words: GnRH, Pregnancy, Dairy Cows

T261 Human chorionic gonadotropin (hCG) and GnRH influences pregnancy survival and resynchronized ovulation before timed AI in Holstein cattle. B. S. Buttrey*, M. G. Burns, and J. S. Stevenson, *Kansas State University*, *Manhattan*.

Treatment with hCG at 4 to 9 d after AI induced ovulation, increased number of corpus luteum (CL), size of the original CL, and increased serum P4 concentrations in lactating dairy cows (JDS 90:331-340; 2007). We hypothesized that replacing the first injection of GnRH (d –7) with hCG or saline in a Resynch-Ovynch protocol would alter pregnancy rates in cows subsequently diagnosed not pregnant (d 0; Exp. 1) and pregnancy survival in cows subsequently diagnosed pregnant (d 0; Exp. 2). Cows in 4 herds were assigned randomly based on lactation number, number of previous AI, and last test-day milk yield to treatments of 1,000 IU of hCG (Chorulon), 100 µg of GnRH (Fertagyl), or saline 7 d before pregnancy diagnosis. In Exp. 1, cows found not pregnant were given PGF2α (Prostamate; d 0), then inseminated 72 h later, concurrent with a GnRH injection (3 herds) or given GnRH 16 to 24 h before AI at 72 h (1 herd). Pregnancy rates were or tended to be reduced by saline (13.1%; n = 510) compared with GnRH (18%; n = 694; $P < 0.02$) or hCG (16.9%; n = 544; $P = 0.08$). In Exp. 2, among pregnant cows treated, pregnancy survival 4 to 9 wk after initial pregnancy diagnosis differed among herds ($P < 0.001$), but a treatment x herd interaction ($P < 0.01$) also was detected (see table). Ovarian structures were monitored in herd 1 by using transrectal ultrasonography 0 and 7 d after treatment with hCG, GnRH, or saline (Exp. 3). Incidence of a new CL was reduced ($P < 0.05$) in pregnant cows 7 d after treatment. A treatment x pregnancy status interaction ($P < 0.05$) was detected. Incidences of ovulation in open cows were: hCG (52.6%; n = 97), GnRH (47.8%; n = 92), and saline (27%; n = 89), whereas those in pregnant cows were: hCG (56.3%; n = 48), GnRH (25%; n = 48) and saline (7.1%; n = 56). Initiating a Resynch-Ovsynch protocol 7 d before pregnancy diagnosis with saline reduced timed AI pregnancy rates (Exp. 1). In pregnant cows treated with GnRH, pregnancy survival was slightly reduced in 2 of 4 herds (Exp. 2). Incidence of new CL was greater after hCG than GnRH in pregnant cows, but not in nonpregnant cows (Exp. 3).

Table 1. Pregnancy survival in dairy cows (Exp. 2)

	Herd 1	Herd 2	Herd 3	Herd 4	Treatment Σ
Days since AI[1]	23-36	31-37	30-36	32-38	
Treatment*	% (no.)	% (no.)	% (no.)	% (no.)	% (no.)
hCG	95.6 (37)	99.1 (106)	86.4 (103)	94.2 (173)	93.6 (419)
GnRH	76.3 (38)	100 (95)	93.3 (105)	92.6 (175)	93.0 (413)
Saline	84.4 (45)	100 (106)	93.9 (99)	96.1 (153)	95.3 (403)
Herd Σ	85.0 (120)	99.7 (307)	91.2 (307)	94.2 (501)	

*Treatment x herd ($P < 0.05$). [1]Days since AI at treatment with hCG, GnRH, or saline (7 d before pregnancy diagnosis).

Key Words: hCG, GnRH, Ovulation Synchronization

T262 Logistic regression analysis for relationship between the timing of the resumption of normal ovarian cycles and metabolic status in postpartum dairy cows. C. Kawashima*, M. Matsui, E. Kaneko, C. Amaya Montoya, T. Shimizu, N. Matsunaga, K. Kida, Y-I. Miyake, and A. Miyamoto, *Obihiro University of Agriculture and Veterinary Medicine*, *Obihiro, Hokkaido, Japan*.

The duration and severity of negative energy status after parturition are correlated with the interval to resumption of ovarian activity in dairy cows. The aim of our study was to examine the weekly relationship between the timing of the resumption of normal ovarian cycles (NOV) and the metabolic status in postpartum (pp) dairy cows. Blood samples were obtained from 26 multiparous Holstein cows from wk 1 (0 to 6 d after parturition) to wk 10 pp, and measured metabolites (glucose; non-esterified fatty acid, NEFA; total cholesterol; aspartate aminotransferase, AST; γ-glutamyl transpeptidase, γ-GTP), metabolic hormones (growth hormone; insulin-like growth factor-I; insulin) and progesterone concentrations. When the progesterone concentrations in plasma increased to more than 1 ng/ml for 7 to 21 d, the cows was confirmed as having NOV. Cows having the resumption of NOV by wk 3, wk 4 and so on were compared with the remaining cows using logistic regression analysis to identify the independent variables that were effective for predicting the resumption of NOV. The number of cows showing the resumption of NOV by each wk pp was 5 by wk 3, 9 by wk 4, 12 by wk 5, 15 by wk 6, 17 by wk 7, 19 by wk 8 and 22 by wk 9 pp. The analysis showed that the higher probability of the resumption of NOV by wk 3 pp was associated with higher plasma insulin concentrations from wk 1 to wk 3 pp ($P<0.05$). On the other hand, the higher probability of a later (after wk 9 pp) resumption of NOV was associated with higher concentrations of NEFA, AST and γ-GTP ($P<0.05$) in the early pp period. In conclusion, our data suggest that metabolic status in the early pp period influences the timing of the resumption of NOV, in which higher energy status by wk 3 pp has a real-time beneficial effect on early NOV and greater mobilization of body fat stores plus declining of hepatic function in the early pp period has a longer-time inhibitory effect and leads to delayed NOV.

Key Words: Dairy Cow, Metabolic Status, Resumption of Normal Ovarian Cycle

T263 Does synchronization protocol affect conception in lactating dairy cows? J. L. M. Vasconcelos*[1], R. M. Santos[2], B. L. Cardoso[1], F. M. Abreu[1], L. H. Cruppe[1], and S. Soriano[3], [1]*FMVZ-UNESP*, *Botucatu, SP, Brazil*, [2]*UFU*, *Uberlandia, MG, Brazil*, [3]*Faz Colorado*, *Araras, SP, Brazil*.

The objective of this study was to evaluate ovulation, conception and conception of ovulated cows to AI or TAI (Heatsynch+CIDR) protocol, in primiparous and multiparous lactating dairy cows. Lactating Holstein cows, 239 primiparous (36.1±7.2 kg milk/d and 183±139 DIM) and 278 multiparous (39.8±10.7 kg milk/d and 177±139 DIM), from June to August 2006, were randomly assigned to receive one of 2 treatment; AI: cows artificial inseminated 12 h after estrous detection or TAI: cows received HEATSYNCH+CIDR protocol [CIDR insertion (CIDR®1.9mg Pfizer Animal Health) + GnRH (1mL Fertagyl®Intervet) - 7 days - CIDR removed + PGF2α (5mL Lutalyse®Pfizer Animal Health) - 24h - Estradiol Cypionate (0.5mL ECP®Pfizer Animal Health]. Cows detected in estrus were inseminated 12 h later and the remaining were TAI 48 h after the ECP injection. Presence of CL at day seven (ovulation rate) and pregnancy 28 days after AI were evaluated by ultrasonography (Aloka 500; 7.5 MHz linear transrectal probe). The variables: ovulation, conception and conception of ovulated cows were analyzed by the logistic model to evaluate the influence of the covariates (DIM, milk yield, and treatment) on the probability of success for primiparous and multiparous cows. In the primiparous cows, the ovulation, conception and conception of ovulated cows were 92.2; 30.4 and 33.0% for AI group (n=115) and 93.6; 35.5 and 37.9%

for TAI group (n=124). DIM did not affect the ovulation rate but increasing DIM decreased (P=0.028) the conception and conception of ovulated cows. In the multiparous cows, the ovulation, conception and conception of ovulated cows were 85.8; 16.9 and 19.7% for AI group (n=155) and 86.2; 25.2 and 29.3% for TAI group (n=123). Increasing DIM have tendency (P=0.1) to decrease the ovulation rate. TAI cows had tendency (P<0.1) to have higher conception and conception of ovulated cows than cows that were bred after heat detection. Theses results shows that TAI (Heatsynch+CIDR) protocol could increase conception in multiparous lactating dairy cows.

Key Words: Synchronization, Conception, Dairy Cows

T264 Effect of physiological status on the concentrations of progesterone maintained by CIDRs in Holstein cattle. K. T. Wolf*, A. K. Sanders, D. L. Ray, and W. J. Silvia, *University of Kentucky, Lexington*.

The concentrations of progesterone (P) maintained by EAZI-BREED CIDR® Cattle Inserts (Pfizer, New York, NY) were examined in nonpregnant Holstein cattle of three different physiological states: lactating cows (LACT, AVE DIM 112, AVE milk production 42 kg/day), nonlactating cows (DRY) and breeding age heifers (HEIF). Ovaries were scanned ultrasonographically to confirm the presence of a mature corpus luteum. CIDRs were inserted into each animal on the day of CL detection (expt day 0) and removed after 7 days. Each animal received two injections of prostaglandin F2α (Lutalyse® Sterile Solution, Pfizer, 25 mg each, i.m.), the first on the morning of day 1, the second 12 h later, to induce luteolysis. In replicate 1 (LACT n = 6; DRY n = 4; HEIF n = 5), coccygeal blood samples were collected twice daily from day 0 to 9 to quantify P. The concentration of P maintained by the CIDR (CIDR-P) was defined as the mean concentration in samples collected from the AM of day 3 (after luteolysis was complete) through the AM of day 7 (when CIDRs were removed). Milk production was recorded at each milking on days 0 to 9. Body weights were recorded on days 0 and 9. Replicate 2 (LACT n = 9; DRY n = 6; HEIF n = 4) was conducted as Replicate 1 except that blood samples were collected daily from the jugular vein and daily feed intakes were recorded. The effect of physiological state on CIDR-P was determined by ANOVA with replicate and body weight included as covariates. There was an effect of body weight ($p < 0.01$) and physiological state ($p < 0.01$) on CIDR-P. CIDR-Ps were 2.6±0.3 (mean±sem), 2.0±0.2 and 1.5±0.1 ng/ml in HEIF, DRY and LACT groups respectively (groups different; $p< 0.05$). Within the LACT group, the relationships between CIDR-P and milk production or CIDR-P and daily feed intake were small (R-square = 0.09 and 0.14, respectively). Differences in CIDR-P are most likely due to differences in clearance rates. Over the ranges examined in this study, differences in CIDR-P among LACT cows could not be explained by differences in the level of milk production or feed intake.

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Key Words: Dairy Cattle, Progesterone, Lactation

T265 Effect of flunixin meglumine at days 15 and 16 after TAI on pregnancy rates in lactating Holstein cows. L. F. M. Pfeifer[1], J. L. M. Vasconcelos*[2], A. Schneider[1], J. Wilson Neto[1], N. J. L. Dionello[1], P. Duarte[1], L. Meneghelo[1], M. N. Correa[1], A. Guzeloglu[3], and W. W. Thatcher[4], [1]*UF Pelotas*, *Pelotas, Brazil*, [2]*FMVZ*, *Botucatu, Brazil*, [3]*Selcuk University*, *Konya, Turkey*, [4]*University of Florida*, *Gainesville*.

Administration of flunixin meglumine to heifers following insemination increased pregnancy rate (PR; Guzeloglu et al., 2006). The objective was to determine if two injections of flunixin meglumine (FM) at days 15.5 and 16.0 to lactating Holstein cows following timed AI would increase PR. The hypothesis is that administration of FM at a critical anti-luteolytic stage of conceptus development will increase PR. The trial was conducted in Brazil from June to September 2006. Lactating Holstein dairy cows (n=87; 30.3±10.2 kg milk/d and 181±152 DIM) were synchronized with one 3 mg norgestomet ear-implant (Crestar®, Intervet) and a 2 mg injection of estradiol benzoate i.m. (EB, Index) given on random days of the estrous cycle. Seven days later 0.53 mg i.m. of sodium cloprostenol, (PGF2α ; Ciosin®, Schering-Plough) was injected, and the implant removed on day 9. Two days later, a 100 µg i.m. of gonadorelin (Fertagyl®, Intervet) was given followed by TAI 12 h later. Cows randomly assigned to the treatment group (n=46) were injected twice with FM (1.1 mg/kg BW; i.m., Banamine®, Schering-Plough) given 12 h apart on the evening of Day 15 and the morning of Day 16. The control group (n = 41) was not treated. PR were the percentage of cows diagnosed pregnant by ultrasonography (Aloka 500, probe 7.5 MHz) at Days 30 and 60 after TAI. Effects of treatment on PR were analyzed by chi-square test. PR in the cows treated with FM were higher at Days 30 and 60 (37 and 37% vs. 17 and 15 %; P<0.05). In lactating dairy cows the beneficial effect of administering two injections of FM at days 15.5 and 16.0 after a timed AI on PR is due likely to its antiluteolytic effect that attenuates the secretion of PGF2α in a manner that is additive to the antiluteolytic effect of the conceptus. Strategies to optimize the dialogue between conceptus and maternal unit leading to maintenance of the CL warrant further investigation.

Key Words: Pregnancy, Flunixin Meglumine, Lactating Cows

T266 Effect of GnRH administered four days after synchronization of ovulation and timed AI on fertility of anovular lactating dairy cows. R. A. Sterry*[1], E. Silva[1], D. Kolb[2], and P. M. Fricke[1], [1]*University of Wiscosin-Madison*, [2]*Lodi Veterinary Clinic*, *Lodi, WI.*

In a previous study (Sterry et al., 2006; JDS 89:4237), treatment with GnRH 5 d after first postpartum TAI increased fertility for anovular but not cycling cows. To further assess this effect, lactating Holstein cows (n=1047) were submitted for first postpartum timed AI (TAI) using a Presynch + Ovsynch protocol, and cows were classified as anovular (n=156) vs. cycling (n=891) using transrectal ultrasonography based on the presence or absence of a corpus luteum (CL) at the first GnRH injection of Presynch + Ovsynch. Anovular cows were randomly assigned to receive either no further treatment (Control, n = 85), or 100µg GnRH 4 d after TAI (G4; n = 71). Ovarian structures were examined using transrectal ultrasonography and blood samples were collected to assess serum progesterone (P_4) at the first GnRH and $PGF_{2\alpha}$ injections of Ovsynch and 4 and 11 d after TAI. For G4 cows, 51% responded by ovulating a follicle in response to GnRH treatment 4 d after TAI; however, pregnancies per AI (P/AI) did not differ (P = 0.24) between G4 cows that ovulated (36%) compared to G4 cows that did not (21%). In addition, control and G4 cows in which an ovulation

was synchronized after Presynch + Ovsynch had similar (P = 0.39) serum P_4 concentrations 11 d after TAI (4.9 vs. 5.3 ng/mL), whereas G4 cows failing to ovulate to GnRH treatment 4 d after TAI had lower (P = 0.06) P_4 (3.9 ng/mL) than control cows and G4 cows that ovulated. Overall, P/AI did not differ (P = 0.89) between control (30%) and G4 (30%) cows. There was a quadratic effect of P_4 at the $PGF_{2\alpha}$ injection of Ovsynch on P/AI, and cows with $P_4 \geq 1.0$ ng/mL at the $PGF_{2\alpha}$ injection of Ovsynch had greater (P < 0.01) P/AI (41%) than cows with $P_4 < 1.0$ ng/mL (12%); however, no treatment difference (P = 0.76) was detected. Although treatment of anovular cows with GnRH 4 d after TAI failed to affect fertility, variation among cows in serum P_4 at the $PGF_{2\alpha}$ injection of Ovsynch dramatically affected fertility of anovular cows.

Key Words: Anovular, Dairy Cow, Ovsynch

T267 Effect of human chorionic gonadotropin or gonadotropin releasing hormone injected 5 or 7 days after 72 h Co-Synch on first service pregnancy rates in lactating dairy cows. R. L. Nebel*[1], J. M. DeJarnette[1], D. A. Whitlock[1], C. E. Marshall[1], M. R. Mink[2], and R. Kasimanickam[2], [1]*Select Sires Inc.*, *Plain City, OH*, [2]*Virginia-Maryland Regional College of Veterinary Medicine*, *Blacksburg*.

Pregnancy failure has been associated with low concentrations of progesterone (P4) as early as d 6 after AI. Normally, blood P4 (timing and magnitude) achieves greater concentrations earlier in pregnant cows. Both human chorionic gonadotropin (hCG) and gonadotropin releasing hormone (GnRH) may increase peripheral concentrations of P4 when given early after AI, either by enhanced endogenous function of the existing CL or by inducing an accessory CL. Two trials were conducted to evaluate the effects of a 5 or 7 d post-AI injection of 100 µg of GnRH or 5 d post-AI injection of 3,300 i.u. of hCG. Cows received Presynch + 72 h Co-Synch with timed AI between 72 and 78 DIM. In trial 1, cows (n = 922) were assigned to receive no post-AI injection or GnRH either 5 or 7 d after AI. In trial 2, cows (n = 513) were assigned to receive hCG 5 d post-AI or serve as non-treated controls. Pregnancy was diagnosed by using transrectal ultrasongraphy and reconfirmed in pregnant cows 21 to 27 d later by transrectal palpation. In trial 1, post-AI GnRH treatment did not affect pregnancy rates (PR). Primiparous cows tended (P = 0.06) to have higher PR (32.8%) than multiparous cows (27.6%), but no interaction with GnRH treatment was detected. In trial 2, post-AI hCG treatment did not affect PR (38.4% vs. 42.3% for control vs. hCG, respectively). Primiparous cows had a higher (P < 0.05) PR (40.4%) than multiparous cows (30.8%), but hCG had no influence on this relationship. A trend (P = 0.09) was detected for higher PR in the Autumn/Winter (46.3%) vs. Summer (35.7%). Though a numeric advantage favoring hCG treatment was observed in Spring (33.2 vs. 45%) and Summer (33.9 vs. 37.5%), the treatment by season interaction was not significant. We concluded that GnRH given either 5 or 7 d post-AI or hCG given 5 d after AI did not increase PR for cows that received timed AI following a 72 h Co-Synch protocol for first service.

Key Words: GnRH, hCG, AI

T268 Effect of time of AI and supplemental estradiol on reproductive performance of dairy cows. J. Hillegass*, F. S. Lima, M. F. Sa Filho, and J. E. P. Santos, *Veterinary Medicine Teaching and Research Center, Univesity of California Davis*, *Tulare*.

Objective was to compare pregnancy rate of dairy cows time-inseminated either at 48 or 72 h after PGF2a and receiving or not estradiol cypionate (ECP) prior to AI. Holstein cows, 971, were randomly assigned to one of four treatments as a 2×2 factorial. All cows received injections of PGF2a at 37 and 51 d in milk (DIM). At 64 DIM, they received GnRH, followed 7 d later by PGF2a. Cows in the CoSynch 48 h (CoS48) received a final injection of GnRH at the moment of timed AI 48 h after PGF2a, whereas cows in the CoSynch 72 h (CoS72) received GnRH and were timed AI 72 h after PGF2a. Half of the cows in each CoSynch received an injection of 1 mg of ECP 24 h after PGF2a (CoS48-NECP, n = 240; CoS72-NECP, n = 246; CoS48-ECP, n = 245; and CoS72-ECP, n = 240). Concentration of progesterone was measured at 57 and 64 DIM to determine cyclic status. A subset of 123 cows had their ovaries examined by ultrasonography to determine diameter of ovulatory follicle and ovulation rate, and blood was sampled 7 d after AI to measure progesterone. Pregnancy was diagnosed at 40 and 68 d after AI. Prevalence of anovular cows at 64 DIM was 27.6%, but it was similar for CoSynch (P=0.67) and ECP (P=0.45). Estrous detection increased (P<0.001) with CoS72 compared with CoS48 (64.5 vs 46.5%) and with supplemental ECP (69.8 vs 41.4%), and cows in estrus had greater (P<0.001) pregnancy rates than those not in estrus (54.7 vs 31.5%). Ovulatory follicle diameter was smaller (P=0.05) in ECP-treated cows, but ovulation rate, double ovulation rate and progesterone concentrations on d 7 after AI did not differ (P>0.10) among treatments. Pregnancy rates at d 40 and 68 after AI were not influenced (P>0.10) by either time of AI or ECP, and at 40 d they were 41.3, 46.7, 45.5 and 43.9 for CoS48-NECP, CoS48-ECP, CoS72-NECP, and CoS72-ECP, respectively. Results indicate that delaying the day of AI from 48 to 72 h and supplemental ECP, in spite of increasing display of estrus at timed AI, did not improve reproductive performance of lactating dairy cows at first AI.

Key Words: Dairy Cow, Estradiol Cypionate, Timed AI

T269 Strategies to maximize ovulation to first GnRH of Ovsynch in lactating dairy cows. N. M. Bello* and J. R. Pursley, *Michigan State University*, *East Lansing*.

Ovulatory response to first GnRH of Ovsynch is a critical determinant for successful synchronization of ovulation in dairy cows. Previous work from our laboratory indicated that 1) a 6-d interval between a $PGF_{2\alpha}$-and-GnRH-based pre-Ovsynch treatment (G6G) and first GnRH of Ovsynch increased the percentage of cows that ovulated in response to first GnRH of Ovsynch; and that 2) size of the follicle that ovulated to 1st GnRH of Ovsynch was positively associated with length of the pre-Ovsynch treatment. Our objective in this study was to evaluate further $PGF_{2\alpha}$-and-GnRH-based pre-Ovsynch strategies of longer intervals between pre-Ovsynch GnRH and first GnRH of Ovsynch. We hypothesized that a longer interval of follicular growth would maximize ovulation at initiation of Ovsynch. Lactating dairy cows (n=165) were assigned to receive either no treatment prior to Ovsynch (Control) or 25 mg of $PGF_{2\alpha}$ (Pre-P) followed 2 d later by 100 µ of GnRH (Pre-G), administered 6 (G6G), 7 (G7G) or 8 (G8G) d prior to first GnRH of Ovsynch. Transrectal ultrasonography was performed to assess follicular size and ovulation throughout Ovsynch. Proportion of cows that ovulated to first GnRH of Ovsynch was 67.5, 94.4, 82.0 and 72.7 % for controls, G6G, G7G and G8G, respectively,

and was greater for G6G versus controls (P<0.02). However, ovulatory response to first GnRH of Ovsynch depended on response to the pre-Ovsynch treatment (P<0.05). In cows that responded to pre-Ovsynch by initiating a new estrous cycle, percentage ovulatory response to first GnRH of Ovsynch was less for G8G (74.0 %; P<0.05) compared to G6G or G7G (96.6 and 92.6 %, respectively). Concentrations of progesterone at $PGF_{2\alpha}$ of Ovsynch were greater for cows that received pre-Ovsynch treatments (5.3±0.4, 4.5±0.5 and 4.4±0.5 ng/ml for G6G, G7G and G8G, respectively) compared to controls (2.4±0.4 ng/ml; P<0.04). In summary, maximal ovulatory response to first GnRH was obtained with a $PGF_{2\alpha}$-and-GnRH based Pre-Ovsynch strategy with either a 6- or 7-d interval between Pre-G and first GnRH of Ovsynch.

Key Words: Dairy Cow, Ovsynch, Ovulation

T270 Pregnancy rates to timed-AI of dairy cows treated with pLH or GnRH. M. G. Colazo*[1], D. J. Ambrose[1], and R. J. Mapletoft[2], [1]*Alberta Agriculture and Food*, *Edmonton, AB, Canada*, [2]*WCVM, University of Saskatchewan*, *Saskatoon, SK, Canada*.

We investigated the use of 25 mg porcine LH (pLH; Lutropin-V, Bioniche Animal Health) or 100 µg GnRH (Fertiline; Vetoquinol NA Inc.) and 500 µg cloprostenol (PG; Estrumate, Schering Plough Animal Health) on ovulatory response and pregnancy rate following timed-AI (TAI) in lactating dairy cows (n = 292). Cows (mean ± SE; 2.4 ± 0.08 lactations, 112.5 ± 3.7 DIM) at two locations were assigned to receive 1 of 4 treatments: GnRH/PG/GnRH, pLH/PG/GnRH, GnRH/PG/pLH or pLH/PG/pLH. Cows were treated at random stages of the estrous cycle with pLH or GnRH im on Day 0, PG im on Day 7, and pLH or GnRH on Day 9 with timed-AI (TAI) 12-16 h later (Day 10). Ultrasonographic examinations were performed in a subset of 216 cows on Days 0, 7, 10, 11, and 14 for ovulation, CL and follicle development, and in all cows on Day 32 for confirmation of pregnancy. Data were compared using GLM and CATMOD procedures in SAS. Proportion of non-cycling cows and cows with ovarian cysts on Day 0 were 14 and 6%, respectively. Ovulatory response to first treatment was 63 vs. 43% for pLH and GnRH groups and 84 vs. 49% for non-cycling and cycling cows (P<0.01). Pregnancy rate to TAI did not differ among treatment groups (P>0.05; 31, 24, 36, and 29% for GnRH/GnRH, pLH/GnRH, GnRH/pLH and pLH/pLH, respectively) but tended to be higher in cows given GnRH on Day 0 (P=0.07; 34 vs 26%). Location, ovulatory response to first pLH or GnRH, cyclicity status, presence of an ovarian cyst, and preovulatory follicle size did not affect pregnancy rate (P>0.05). However, cows that ovulated before TAI (11%) tended to have lower pregnancy rate (P=0.1; 17 vs. 31%). In addition, none of the cows that failed to respond to PG (12%) or ovulate following the second pLH or GnRH treatment (15%) conceived (P<0.01). In summary, cows treated with GnRH on Day 0 had lower ovulation rate but tended to have higher pregnancy rate to TAI. However, pregnancy rate to TAI did not differ among treatment groups.

Key Words: Porcine LH, GnRH, Pregnancy Rate

T271 Prepartum feed restriction and fatty acid supplementation influence reproductive performance of dairy cows. M. G. Colazo*[1], D. J. Ambrose[1,2], A. Hayirli[2], and L. Doepel[2], [1]*Alberta Agriculture and Food*, *Edmonton, AB, Canada*, [2]*University of Alberta*, *Edmonton, AB, Canada*.

We determined the effects of feed restriction and fatty acid supplementation during the dry period on post-calving reproductive performance of dairy cows. Thirty-four d before expected calving, pregnant dairy heifers (n=25) and cows (n=47; 1 to 4 lactations) were randomly assigned to 1 of 6 treatments. Treatments were ad libitum (AL) or 30% restricted (FR) feed intake in combination with 1 of 3 oilseed supplements at 8% of diet DM: canola(C), linola (L) or flax (F) to supply oleic, linoleic or linolenic fatty acids, respectively. After calving, cows were fed a common lactation diet. Measurements of uterus, corpus luteum and follicles were determined by ultrasonography (US) twice weekly from 7 ± 1 d after calving until first ovulation and thereafter every other day until second ovulation. Cows (n=63) were timed-AI (TAI) and 32 d later, pregnancy was diagnosed by US. Data were analyzed using proc GLM and CATMOD. Although none of the animals in FR-L group had retained placenta and/or endometritis (RPE), diets did not affect the incidence of RPE (18%), mastitis (10%) or metabolic diseases (7%). Mean (± SE) interval from calving to uterine involution did not differ among diet groups, but it was longer in cows that had RPE (P<0.02; 32.1 ± 2.7 vs. 24.8 ± 1.3 d). Interval from calving to first ovulation was longer (P<0.05) in cows fed C than those fed either L or F (34.7 ± 3.1, 23.7 ± 3.2 and 21.0 ± 3.1 d, respectively) and in cows with follicles <10 mm at first US (35.1 ± 2.4 vs. 23.8 ± 2.8 d). Conception rate was higher in cows fed AL than in those fed FR (P<0.05; 50 vs. 19%), and in cows with 1 than either 2 or >2 lactations (P<0.02; 56, 18 and 29%, respectively). Conception rates tended (P<0.1) to be lower in cows that had RPE (22 vs. 46%) or that had not ovulated within 4 wk after calving (21 vs. 46%). In summary, cows fed diets supplemented with linola or flaxseed ovulated sooner, and cows with ad libitum feed intake had higher conception rate. Conception rate tended to be higher in cows without RPE, in cows ovulating within 4 wk postpartum, and in first lactation cows.

Key Words: Feed Restriction, Fatty Acid Supplementation, Reproductive Performance

T272 Evaluation of feed restriction and pre-synchronization in a program for estrous synchronization. P. Molina[1], T. Sánchez[1], O. Mejía[2], J. Nuñez[2], E. García*[3], O. D. Montañez-Valdez[4], J. Cordero[1], J. Peralta[1], M. E. Ortega[1], R. Nieto[5], E. Mendoza[1], and R. Avila[1], [1]*Colegio de Postgraduados*, *Montecillo, Estado de México, México*, [2]*Facultad de Medicina Veterinaria y Zootecnia, UNAM*, *Tres Marías, Municipio de Huitzilac, México*, [3]*Centro Universitario de la Costa Sur de la Universidad de Guadalajara*, *Autlán, Jalisco, México*, [4]*Centro Universitario del Sur de la Universidaad de Guadalajara*, *Ciudad Guzmán, Jalisco, México*, [5]*Instituto Tecnológico Agropecuario No.6*, *Huejutla, Hidalgo, México*.

The objective of the experiment was to evaluate the effect of pre-synchronization and feed restriction in the onset, beginning and duration of estrus. Sixty nine Dorset ewes were randomly assigned to four treatments: Treatment 1 (T1): Ewes received one kg of commercial supplement (16% protein) plus one kg of oats straw for 30 days and were synchronized with fluorogestone acetate sponges (FGA, 40 mg) for 12 days; Treatment 2 (T2) ewes received the same diet as T1, but they were synchronized with two doses of $PGF_{2\alpha}$ 16 and 8 days before the FGA sponges; Treatment 3 (T3) ewes were feed restricted and only received 1 kg of oats straw during 30 days, with the same

synchronization regime as T1; and Treatment 4 (T4) received the same diet as T3 and the synchronization regime as T2. A hundred percent of estrus onset for all treatments, but there were differences in beginning of estrus between T4 and T2 with an average time of 50.4 ± 1.83 and 40 ± 2 h, respectively, while for T1 and T3 the average time was 46 ± 2.10 and 49.8 ± 2.88 h (P>0.05). Beginning of estrus was affected for feed restriction, and restricted ewes (T3 and T4) showed estrus later (50.06 ± 1.68 h) compared to not restricted (T1 and T2) ewes (43.09 ± 1.52 h, P<0.05). Duration of estrus was longer in T2 (45.8 ± 2.80 h) compared to T3 (34 ± 1.86), and for T1 and T4 there were 38.7 ±1.37 and 41.3 ± 2.15 h, respectively (P>0.05). In treatments pre-synchronized with $PGF_{2\alpha}$ (T2 and T4) duration of estrus was longer compared with not pre-synchronized, with 43.6 ± 1.80 h and 36.6 ± 1.17 h respectively (P<0.05), while feed restriction did not affect duration of estrus (P>0.05). We conclude that feed restriction affects beginning of estrus, while pre-synchronization prolongs duration of estrus.

Key Words: $PGF_{2\alpha}$, Ewes, FGA

T273 Please see abstract # 281.

T274 Please see abstract # 287.

Production, Management & the Environment - Livestock and Poultry II

T275 Human resource management and dairy employee organizational commitment. R. E. Stup*, *The Pennsylvania State University*, *University Park*.

The purpose of this research was to gather information about human resource management (HRM) practices used on dairy farms and effects these practices had on employees' feelings of commitment toward the farm. HRM practices included in the study were selection, benefits, training, performance feedback, communication systems, standard operating procedures, and employee participation. Organizational commitment is the strength of an employee's attachment to the organization where he is employed. Employees committed to the organization are less likely to leave for another job and are more likely to perform at high levels. There are three dimensions of organizational commitment: affective commitment is a feeling of emotional attachment, normative commitment is a feeling of obligation, and continuance commitment is a feeling that the costs of leaving are too high or it is too much trouble to go somewhere else. In February 2005 a survey was sent to owners and employees of dairies with herd sizes of 250 or larger in the Northeast. A total of 131 owners and 201 employees responded. Farm-level response rate was 14.8%. The following HRM practices were significantly ($p < .05$) correlated with affective commitment: level of off-farm training, adequacy of initial training, adequacy of continuing training, satisfaction with training, informal feedback was provided, satisfaction with feedback, satisfaction with performance reviews, and employee participation. Normative commitment was significantly ($p < .05$) correlated with: adequacy of initial training, adequacy of continuing training, satisfaction with training, informal feedback was provided, satisfaction with feedback, satisfaction with performance reviews, employee participation. Further analysis with stepwise multiple regression found satisfaction with feedback, employee participation, and satisfaction with performance reviews were predictive of affective commitment. The same three HRM variables predicted normative commitment as well. The results suggest that managers should focus on feedback and employee participation to build employee commitment.

Key Words: Human Resources, Employee Commitment, Labor

T276 The amount of concentrate offered in automated milking systems does not influence the frequency of visits of dairy cattle consuming high levels of corn silage. A. Bach*[1,2], C. Iglesias[3], M. Devant[2], and A. Ferrer[2], [1]*ICREA*, *Barcelona, Spain*, [2]*IRTA-Unitat de Remugants*, *Barcelona, Spain*, [3]*SEMEGA*, *Girona, Spain*.

The objective of this study was to evaluate whether the amount of concentrate offered in an automatic milking systems (AMS) would modify milking frequency, feeding behavior, and milk production. One hundred and fifteen lactating cows were used in a cross-over design with 2 periods of 90 d each and two treatments: LC (up to 3 kg/d of concentrate at the AMS) or HC (up to 8 kg/d of concentrate at the AMS). Cows were evenly distributed in 2 symmetrical pens, each containing 1 AMS and about 50 cows at any given time. All cows received the same total ration (28% corn silage; 1.67 Mcal of NEl/kg; 16.5% CP, DM basis) but a different proportion of concentrate from this ration was offered at the AMS depending on treatment. The concentrate at the AMS had the same composition in both treatments. Cows were fetched when time elapsed since last milking was greater than 12 h. The amount of concentrate offered at the AMS was proportional to the time elapsed since last visit (125 g/h and 333 g/h for LC and HC, respectively). Milk production (32.5±0.89 kg/d), total number of daily milkings (2.7±0.07/d), number of cows fetched (1.2±0.02/d), or number of voluntary milkings (1.5±0.09/d) were not affected by treatments. The consumption of basal ration was greater ($P < 0.05$) in LC (19.0±0.26 of DM/d) than in HC (14.2±0.27 kg of DM /d), but this difference was compensated by a greater ($P < 0.05$) consumption of concentrate at the AMS in HC (6.8±0.02 kg of DM/d) than LC (2.6±0.02 kg of DM/d) cows. Therefore, total DMI was unaffected. The eating rate of the basal ration was greater ($P < 0.05$) in LC (113.2±0.23 g of DM/min) than in HC (80.7± 0.21 g of DM/min), but the total amount of time that cows devoted to eat was similar between treatments (171.7±5.11 min/d). Offering high amounts of concentrate to the AMS feeding a basal ration rich in corn silage is not an effective method to diminishing cow fetching and increasing number of daily milkings and milk production.

Key Words: Automatic Milking, Concentrate

T277 Effects of dam's dry period length on calf. M. T. Kuhn*, J. L. Hutchison, and H. D. Norman, *Animal Improvement Programs Laboratory*, *Beltsville, MD*.

Recommendations for shortened dry periods have become increasingly common in recent years. While considerable research has been done to determine effects on cow performance, research to determine what,

if any, effect shortened dry periods have on the calf being carried is quite limited, in spite of the fact that in utero weight gain of the calf increases at an increasing rate during gestation, with more than half of fetal weight gain occurring during the last 2 months of gestation. Field data were utilized in this research to compare calving ease (CE) scores and stillbirth (SB) rates across 16 days dry (DD) categories. Heifer ages at first breeding (AFB) were also compared across dam DD categories and the raw percentage of heifers with a first calving was also calculated for each category. The linear, fixed effects model for analysis of CE and SB included herd-year of calving, year-state-month of calving, parity, sex of calf, and DD category. Parity and sex of calf were dropped from this model for analysis of calves' AFB. A total of 454,091 CE, 163,175 SB, and 24,125 AFB records were included for analysis. The number of records for AFB was much smaller because only about 29% of US herds have heifer breedings recorded in the national database and storage of heifer breedings only began in 2003. Although differences were small, CE scores did tend to be lower for dry periods of 0 to 45 d than for 46 to 65 DD, suggesting that calves may be smaller with shorter dry periods. Stillbirths were 1.3% higher for dry periods of 30 d or less, compared to DD between 61 and 65 d. There was no evidence to support an effect on AFB for heifers surviving to breeding age; subclass sample sizes, however, were small and further investigation of this trait may be warranted when more data is available. Simple averages indicated that heifers born after dry periods of 45 d or less survived to first calving 12% less often than heifers born after dry periods of 56 to 70 d. Further research on survival to first calving, adjusting for extraneous effects, is warranted. Results to date indicate a small, but real, negative impact on the calf for dry periods less than 45 d.

Key Words: Days Dry, Survival

T278 An analysis of the relationship between wash water quality and bulk tank milk quality on Ontario dairy farms. N. R. Perkins*[1], D. F. Kelton[1], K. E. Leslie[1], K. J. Hand[2], G. MacNaughton[3], and O. Berke[1], [1]*University of Guelph*, *Ontario, Canada*, [2]*CanWest DHI*, *Guelph, Ontario, Canada*, [3]*Dairy Farmers of Ontario*, *Mississauga, Ontario, Canada*.

The objective of the study was to identify areas of high risk of wash water contamination and to investigate the relationship between bacteria contaminated wash water and elevated Bactoscan bacteria counts in raw milk. Water quality analysis was conducted by the Dairy Farmers of Ontario on all of the 5000 farms in the province on an annual basis, during 2003 and 2004. These water quality data, matched with bacteria counts (Bactoscan determinations) in raw milk during the same time period, were evaluated using linear regression to evaluate the relationship between water contamination and bacteria counts in raw milk. After controlling for potential confounders, the data was used to determine whether the presence of coliform and/or *E.coli* bacteria in the water was associated with an elevated Bactoscan level in raw milk. In addition to regression analysis, the first water quality sample was utilized in a spatial analysis to quantify the prevalence of water contamination and to identify any geographic case cluster formations within the data. An *E.coli* case farm and similarly, a coliform case was any farm that had >0 of the respective bacteria within the water sample. The significant ($p<0.05$) factors associated with Bactoscan levels in raw bulk tank milk in the linear regression analysis included: the presence of *E.coli* bacteria in wash water, an interaction between average herd monthly somatic cell count (SCC) and season, and an interaction between total monthly milk production and average herd monthly SCC. The spatial analysis performed separately for coliforms and *E.coli* identified one cluster of coliform cases and three clusters of *E.coli* cases in southern Ontario. The prevalence of bacteria in wash water is a concern within Ontario, since pasteurization does not kill all bacteria within raw milk. Therefore, milking equipment should be properly cleaned and sanitized in order to ensure the production of a high quality, safe milk product.

Key Words: Raw Milk, Wash Water, Bacteria

T279 Body weight of Holstein heifers as measured by heart girth tape and electronic scale: A comparison. J. E. Wohlt*[1], C. E. Reich[1], and J. Ferguson[2], [1]*Rutgers University*, *New Brunswick, NJ*, [2]*University of Pennsylvania*, *Kennett Square*.

Holstein heifers, 3 to 18 mo, were weighed once monthly (June, July, August, September 2006; n = 128/mo, total n = 514) first by tape (Weight-By-Breed, NASCO) and then on an electronic scale (Allflex Technologies). This comparison was necessary as a 2 y growth database on heifer body weight had been generated using a tape. Data were analyzed by ANOVA using GLM procedures with method and month main effects in the model and pen as a covariant. Body weight was 11 kg greater ($P<0.01$) by scale than tape: 279 vs. 270, 260 vs. 251, 275 vs. 258, 285 vs. 276; respectively by month. The frequency that scale weights were greater than tape weights was constant by month: 74, 70, 76, and 69%; respectively. Method was also evaluated for different levels of body weight: 45.4 kg increments for heifers weighing 91 to 499 kg. Scale weights differed from tape weights only when heifers exceeded 227 kg. Tape and scale weights were significantly ($P<0.01$) correlated: $y = 1.0689x - 7.8$, $R^2 = 0.98$. Growth rate, determined by regression analysis, did not differ when heifer body weight was measured by tape or scale (0.81 vs. 0.82 kg/d). All producers should be monitoring heifer growth. Many methods are available and selection of a method should be appropriate for available facilities, labor and time constraints. If method of weighing changes, then comparisons should be done and correction factors applied to assess body weight data.

Key Words: Dairy Heifer, Tape Weight, Scale Weight

T280 Dairy farm sustainability: The economic component indicators. D. L. Larochelle*, D. P. Parent, G. A. Allard, and D. P. Pellerin, *Laval University*, *Quebec, Quebec, Canada*.

Over the last two decades, the number of dairy farms has declined dramatically and the viability of the family farm has been questioned. A comprehensive research project has been set to evaluate the sustainability of Quebec dairy farms based on their economic, environmental and social components. The objective of the present study was to develop indicators to evaluate the economic sustainability. To identify these indicators, experts working in various areas such as animal production, farm management and financial institutions have been consulted using the Delphi method. This method uses a qualitative sequential approach: each expert submits his own indicators which are later debated in a focus group; the chosen indicators are then classified and ranked and for each indicator, different threshold levels are established by the group to determine the score values.

Indicators are selected based on their sensitivity to predict the economic component of dairy farm sustainability considering the availability and easiness with which the data can be collected and analyzed. From the 139 indicators initially submitted, eight were selected and grouped in five categories. For a total score of 100 points, their weights are:
A- Technical management (/20): 1- Milk yield (L/cow/year). (/8) and, 2- Milk from forage (L/cow/year), (/12)
B- Economic viability (/25): 3- Security margin (Net return surplus on gross income, %), (/15) and, 4- Total farm debt per hectolitre ($/hL), (/10)
C- Expense control (/30): 5- Operational expenses on gross income (%), (/20) and, 6- Machinery expenses per hectolitre ($/hL), (/10)
D- Labor efficiency (/15): 7- Milk per full time worker (FTW), (L/FTW), (/15)
E- Self-sufficiency (/10): 8- Self-sufficiency of forage usage on farm (%), (/10)

The overall score for a given farm is obtained by adding the individual score for each indicator and farms can be compared for their economic sustainability. This new tool will help to evaluate the sustainability of dairy farms at a given point in time and it becomes possible to follow their evolution over the years.

Key Words: Sustainability, Indicators, Farms

T281 A comparison of body temperature measures between Holstein and Gir × Holstein cows in relation to environment and stage of the estrous cycle. S. Dray*, A. Harris, R. Farrar, G. Grissett, S. Laird, and S. Willard, *Mississippi State University*, *Mississippi State*.

Gir × Holstein (G×H) cows have higher body surface and lower rectal temperatures (RT) than Holstein (HOL) cows under heat-stressed conditions. However the influence of coat color and stage of the estrous cycle on body temperatures (BT) have not been evaluated, therefore our objective was to compare BT responses of HOL vs. GxH cows in relation to these parameters (coat color and estrous cycle) during summer heat stress. Non-lactating HOL [n=5 white (WH); n=6 black (BH)] and GxH [n=7 dark (DK); n=4 light (LT)] cows were fitted with the HeatWatch estrus detection system, and an intravaginal temperature (VT; °C) probe inserted to acquire VT (5 min intervals; July-Sept). Cows received two injections of $PGF_2\alpha$ 11 d apart to synchronize estrus (d -10 and 0). From d -10 to d 46 (56 d), measurement periods were conducted weekly (three times AM and five times PM weekly) and included: ambient temperature (AMBT; °C), temperature-humidity index (THI), rectal temperature (RT; °C), respiration rate (RR; breaths per min), digital infrared thermography of the eye (maximum eye temperature; MAX-EYE, °C), and a blood sample (serum) for progesterone (P4) by RIA. Cow BT was analyzed in relation to environmental measures and stage of the estrous cycle [luteal (LUT) vs. follicular (FOL) phases]. Environmental AMBT differed ($P<0.01$) AM vs. PM, with THI ranging from 69.8 to 90.6. Dark (DK) and LT G×H cows did not differ ($P>0.10$) in BT AM or PM. During AM, BH were similar ($P>0.10$) to WH, but differed ($P<0.05$) in PM. Body temperature of HOL cows increased (VT and MAX-EYE; $P<0.05$) from AM to PM, while G×H cows decreased (VT; $P<0.05$) or increased only slightly (MAX-EYE; $P<0.10$) depending on the BT measure. Holstein cows had a greater ($P<0.05$) increase in RR from AM to PM than GxH cows. Body temperature did not differ ($P>0.10$) between breeds within LUT and FOL. Rectal temperature and MAX-EYE did not differ ($P>0.10$) between LUT and FOL, while VT was greater ($P<0.05$) during LUT than FOL. In summary, non-lactating HOL and G×H cows were similar in BT measures during the estrous cycle and in the AM. In the PM, HOL cows exhibited higher BT and RR (affected by coat color) than G×H cows.

Key Words: Gir × Holstein, Body Temperature, Environment

T282 Evaluation of the pedometer system efficiency. R. M. Santos*[1], J. L. M. Vasconcelos[2], and S. Soriano[3], [1]*UFU*, *Uberlândia, MG*, [2]*FMVZ-UNESP*, *Botucatu, SP*, [3]*Fazenda Colorado*, *Araras, SP, Brazil*.

Detection aids which measure changes in activity, mucus conductivity, number of mounts or temperature can be used to improve estrous detection. The pedometer systems register the number of steps an animal takes. As cows in estrus are restless and move around more, an increased pedometer reading may indicate estrus, but high percentage of false positive reactions have been reported. The objective of this study was to evaluate the pedometer system efficiency by using ultrasound examinations weekly. Cycling and not pregnant lactating Holstein cows (n = 89) producing 40.3 ± 8.84 kg milk/d and with more than 40 DPP, housed in a free-stall barn with concrete flooring received a pedometer (pedometers were strapped on the left front leg of each cow and pedometer measurements were recorded three times a day) on day of parturition. The cyclicity was determined by the presence of a corpus luteum (CL) on day 0 of the experiment. During the study (28 days) ovaries were scanned by ultrasound (Aloka-500; 7.5 MHz) once a week, to detect CL regression, ovulation and CL development. Correct pedometer detection was considered when the pedometer system detects the cow in estrous and the original CL regress and a new CL was formed. The false negative was considered when the CL regress but the cow was not detected in estrous by the pedometer system. The false positive was considered when cow was detected in estrous by the pedometer system but the CL did not regress. During the 28 days of experiment the pedometer system appointed 95 heats, 81 (85.3%) were correctly detected and 14 (14.7%) were false positive. Eight heats were not appointed (false negative) by the pedometer system (8.9%; 8/89) during the experimental period. The overall efficiency was 78.6% (81/103). In conclusion, the pedometer system can detect estrus with high efficiency and could be used as a tool for improving service rates.

Key Words: Estrous Detection, Pedometer, Dairy Cow

T283 Effect of nitrogen intake, straw and days of storage on pH, temperature and ammonia emission from dairy cow manure. M. J. Aguerre*[1], M. A. Wattiaux[1], and T. Hunt[2], [1]*University of Wisconsin*, *Madison*, [2]*University of Wisconsin*, *Platteville*.

An experiment was conducted to determine the effects of nitrogen intake and wheat straw addition on NH_3-N emission during manure storage. Two groups of cows (160 vs. 260 DIM) producing 36 and 27 kg/c/d of milk were assigned diets with 17 and 15% CP (DM basis), leading to high nitrogen (**HN**) and low nitrogen (**LN**) intakes, respectively. Manure collected from the barn floor was thoroughly mixed, diluted with water to 10% DM, loaded in 200 L barrels (186

kg) with or without addition of chopped straw (22 g/kg of undiluted manure) and stored in a partially temperature-controlled environment. Manure temperature and pH were recorded and NH_3-N emitted for a 2-hr period was captured in an acid trap on days 0, 3, 6, 12, 28, and 56. Data were analyzed as a randomized complete block with a 2×2 factorial arrangement of treatments and three replications (one in May and two in October). Concentration of NH_3-N in manure at day 0 was 80.0 and 53.8 mg/dl for **HN** and **LN** treatment, respectively; but was not influenced by straw addition. There was no significant effect of straw and no interactions for the reported measurements. Mean manure pH was significantly higher for **HN** than **LN** treatment (see Table). Temperature increased but pH decreased with days of storage. On average NH3-N emission was reduced by 46% on **LN** relative to **HN** treatment. Emission of NH_3-N was highest at day 0, declined to reach a nadir at day 6, and increased numerically thereafter. At day 56 NH_3-N emission was still 44% of day 0 emission. In this trial, NH_3-N emission was correlated with manure pH (r=+0.57, n=72), but not with temperature.

Table 1.

	Treatment		Day[1]						P-value[2]
Item	LN	HN	0	3	6	12	28	56	N Intake
pH	6.42	6.80	8.15^{a}	6.83^{b}	6.61^{c}	6.20^{d}	5.96^{e}	5.94^{e}	<0.01
Temp, °C	17.0	17.0	15.7^{b}	16.2^{b}	15.4^{b}	17.9^{ab}	17.6^{ab}	19.6^{a}	0.97
NH_3 –N, g/m^2 /h	1.13	1.99	2.61^{a}	1.49^{b}	1.12^{c}	1.51^{bc}	1.46^{bc}	1.16^{bc}	0.05

[1, 2] Means within a row with different superscript differ (P<0.05). Days of storage P value was <0.01, 0.03 and <0.01 for pH, temperature and NH_3-N emission, respectively.

Key Words: Ammonia, Emission, Manure

T284 Dairy manure estrogens with advanced treatments. Z. Zhao*, K. F. Knowlton, N. G. Love, and Y. Fang, *Virginia Polytechnic Institute and State University*, *Blacksburg*.

In the last few decades, environmental estrogens have raised great concern and interest for their potent endocrine disrupting effects. The objective of this study was to quantify dairy manure estrogens with intensive treatments. In experiment one, 17beta-estradiol (E2) and estriol (E3) were measured in a full-scale manure handling system at Virginia Tech dairy center. This system employs a mechanical separator to separate manure liquids from solids, a short retention time anaerobic settling basin to remove further solids, and three aerated tanks in sequence. The third tank effluent is reused to flush the barn, or applied to crop lands via irrigation. The main slurry from the barn, separator effluent, settling basin effluent, effluent of the first two tanks, and flush water (the third tank effluent) were collected monthly from July 2005 to June 2006. In experiment two, E2 and E3 were determined in the influent and effluent (monthly from August 2005 to April 2006) of an anaerobic digester on a commercial dairy farm. All samples were extracted first with chloroform and NaOH and then with toluene to the base phase after neutralization with acetic acid. E2 and E3 concentrations were assayed via ELISA (Assay Designs, MI). In experiment one, there was a significant difference for both E2 and E3 among sampling locations (P<0.01). Mechanical separation did not affect E2 or E3 content (763.0 and 470.1 pg/ml, respectively), but flush water had a significantly lower E2 (361.0 vs. 880.9 pg/ml, P<0.01) and E3 (167.4 vs. 636.8 pg/ml, P<0.01) compared to the main slurry. In experiment two, E2 (15.9 vs. 9.86 ng/ml, P<0.05) and E3 (7.88 vs. 5.79 ng/ml, P<0.10) were decreased after anaerobic digestion compared to the influent. In conclusion, both manure treatments reduced potential E2 and E3 loading to the environment. A mass-balance analysis of estrogen flow will help understand better what happened to estrogens within the treatment system.

Key Words: Dairy Manure, Estrogens, ELISA

T285 The impact of intake water temperatures on reticular temperatures of lactating dairy cows. J. M. Bewley*[1], D. C. Batson[2], M. W. Grott[1], and M. M. Schutz[1], [1]*Purdue University*, *West Lafayette, IN*, [2]*MaGiiX Inc.*, *Post Falls, ID*.

Automatic temperature recording may allow early detection of disease, estrus, heat stress, and the onset of calving. The MaGiiX™ Cattle Temperature Monitoring System (CTMS, MaGiiX Inc., Post Falls, ID) utilizes a passive bolus equipped with a temperature sensor, a stationary panel reader to query the bolus, and software to collect, analyze, and view data. The biologically inert bolus resides in the cow's reticulum and is queried each time the cow passes the reader. A potential limitation to collection of reticular temperatures is the impact of water temperature and consumption on observed temperatures. A replicated 3×3 Latin Square study was conducted at the Purdue Dairy Research and Education Center to assess the impact of water intake on reticular temperatures using the CTMS. Nine high-producing, mid-lactation 2nd parity cows with low SCC, were selected for this trial conducted on January 16, 17 and 19, 2007. Prior to administering a water treatment, access to feed and water was restricted for at least 2 hours. Baseline reticular (RT) temperatures were established from 3 measurements prior to water intake. Each cow received 25.2 kg of water at one of 3 different temperatures on each day. Water temperatures were Hot (34.3°C (±1.0)), Warm (18.2°C (±0.4)), or Cold (7.6°C (±0.4)) and all 3 temperatures were given to 3 cows on each day. Following water intake, RT and RC were collected every 10-15 minutes for 3 hours. The RT for each treatment followed a consistent pattern: an initial dramatic drop in RT followed by a gradual rise toward baseline. However, at the end of the 3 hour collection period RT had not returned to the baseline (-0.34°C ±0.19). Regression was performed with PROC GLM to assess the impact of water treatment on maximum drop (D) in RT (R^2=0.91). Treatment (P<0.001) and day (P=0.037) affected D, while a cow effect (P=0.163) did not. LSMeans for D were 8.4°C (±0.4), 6.9°C (±0.4), 2.2°C (±0.4), for cold, warm, and hot, respectively.

Key Words: Temperature Monitoring, Reticular Temperature, Water Intake

T286 Predicting cow health and estrus status by measuring change in water intake in dairy cows. J. M. Lukas* and J. K. Reneau, *University of Minnesota*, *St Paul*.

Recent studies in swine have investigated the potential of early disease diagnosis by measuring water intake in growing pigs. Little research has been done on measuring water intake in dairy cows or the change in water intake due to disease. The following study attempts to explore the possibility of early disease and estrus detection by monitoring water intake in dairy cows. Daily readings from 41 water meters placed

in the tie stall St Paul Dairy Barn at the University of Minnesota were collected from September 2005 until July 2006. Each water meter measured the water intake from one water cup. Two cows were assigned to each water cup. All treatments administered to the cows along with breeding and calving dates were also recorded and used to create an event list with event class and corresponding event date for each of the 41 groups of two cows assigned to an individual water cup. Events were grouped into the following classes: bred, calved, mastitis, fever, hypocalcaemia, ketosis, feet and other. Average days in milk for each water cup group were calculated for each day of the study period. The average difference in days in milk within the water cup group was 10.5 days (s.e. 1.54). The water intake data was matched with the mean days in milk and merged with the event list dataset. Each event was also assigned to seven days preceding and seven days following the actual occurrence of an event. Proc mixed procedure of SAS was used to identify events significantly changing water intake with event classes entered as fixed and mean days in milk entered as a random effect. Only average days in milk 0 through 150 were considered in the analysis. Hypocalcaemia was associated with significantly increased water intake while occurrence of fever was associated with a tendency (p-value 0.09). Event classes bred, fresh and other were associated with a significant decrease in water intake (p-values <0.05). Monitoring water intake can help in earlier disease diagnosis and has the potential of predicting change in cow health and estrus status.

Key Words: Water Intake, Estrus Detection, Disease Detection

T287 Factors affecting group sizes within herd and group milk volume compared to total herd volume of milk. R. C. Goodling*, K. E. Griswold, and T. J. Beck, *The Pennsylvania State University Cooperative Extension*, *University Park*.

The percent of cows within herd for days in milk (DIM) cow groups or lactation cow groups and the groups contribution to the total herd milk volume was investigated with 2005 DHIA data from 3953 Pennsylvania dairy herds comprised of 2,800,559 Holstein cow test day records. Data were analyzed using the UNIVARIATE and MIXED procedures of SAS version 9.1. The contribution potential of a cow group to the total herd milk volume was estimated as the difference between the percent of the total herd milk volume produced by a defined group of cows and the percent of the total number of lactating cows represented by that group of cows. For example, if cows from 41 to 100 DIM represented 25% of the lactating cows and produced 30% of the total herd milk volume, then their contribution potential would be + 5%. The statistical model included the fixed effects of DIM group, herd size group, and average daily milk yield group. Milking frequency and bST use were excluded from the analysis. DIM groupings were 1 to 40, 41 to 100, 101 to 200, 201 to 300, and 300+. Herd size groupings were < 50 cows, 51 to 99 cows, 100 to 199 cows, and >= 200 cows. Average daily milk yield groupings were < 27.2, 27.2 to 31.8, 31.8 to 36.3, and >36.3 kg per cow per day. Contribution potential was affected (P<0.0001) by DIM group with 1.0, 3.6, 2.5, –2.4, and –4.9% for 1 to 40, 41 to 100, 101 to 200, 201 to 300, and 300+ DIM, respectively. Interactions of DIM group and herd size groups or average daily milk yield groups were also significant (P<0.0001). These significant interactions were seen for both percent of herd group and percent milk contribution.

Key Words: Daily Milk Production, Herd Size, Days in Milk

T288 Milking parlor employee management on Wisconsin dairy farms. K. J. Hohmann and P. L. Ruegg*, *University of Wisconsin*, *Madison*.

The objective of this study was to evaluate milking parlor employee management practices on dairy farms that had previously participated in a team based milk quality improvement program. A mail survey was sent to farms that had registered for the Milk Money program before June 1, 2005 (n = 326) and a 44% response rate (n = 142) was achieved. Responder herds contained 226 cows (20 to 1200), produced 33 kg/cow/day (18 to 45) and had bulk tank SCC of 245,000 cells/ml (17,000 to 900,000). Most farms milked twice (58%) or three times (40%) a day in parlors (55%) or stall barns (36%). Of responder farms, 72% indicated that they trained milking technicians but most trained only when hired (42%) as compared to monthly training (16%), other (14%) or never (28%). Job descriptions were provided for employees on 31% of farms. Spanish was the first language for employees on 52% of farms. Most responders with Spanish-speaking employees spoke no Spanish (24%) or knew only a few words of Spanish (61%) but a few responders indicated that they could speak some Spanish (14%). Communication problems were apparent on farms with Spanish-speaking employees as 39% never used interpreters, while 6%, 14% and 41% used interpreters yearly, monthly or several times per year, respectively. Twenty-nine percent (n = 32) of 111 producers indicated that employee management was their greatest milk quality challenge. Farms that listed employee management as their greatest milk quality challenge were 5.8 times more likely to employ Spanish-speaking persons (P<0.001), 3.3 times more likely to provide job descriptions (P<0.01) and 15.5 times more likely to train milking technicians (P<0.01) as compared to farms that did not list this concern. This data suggests that employee management remains a challenge for farms that desire to produce high quality milk because of communication issues but that these farms are more active in employee management by training and providing job descriptions.

Key Words: Employee-Management, Dairy, Milking

T289 Bluegrass straw as a partial replacement for alfalfa hay in dairy rations. E. M. O'Rourke*, J. J. Michal, and R. L. Kincaid, *Washington State University*, *Pullman*.

The objectives were to determine the potential of bluegrass straw (BGS) as a partial replacement of alfalfa hay in dairy rations, and if the BGS affected P absorption. Thirty multiparous Holstein cows were assigned to a randomized complete design and fed one of three levels of bluegrass straw (0, 10 and 15% of TMR, DMB). NDF concentrations were 35, 39 and 39% DM for the 0, 10 and 15% BGS diets respectively. Cows were fed their respective treatment diet for 62 d with the first 12 d serving as an adaptation period. Individual feed intakes and milk yields were recorded daily. Samples of blood, milk, and feces were collected on d 1, 37, and 62. At the start of the study, cows averaged 219 ± 15.6 DIM, 661 ± 13 kg BW, and 41.1 ± 1.5 kg daily milk yield. Average DMI (25.4 ± 0.2 kg/d) and milk yield (35.2± 0.4 kg/d) were not affected by treatment but declined with time (P ≤ 0.01). Similarly, milk composition was not affected by dietary treatment but also was affected by time. The concentrations of P in the diets were 0.40, 0.40, and 0.39% DM and P intakes were 142.5, 140.5, and 136.2 g/d, respectively, similar (P ≤ 0.1) among treatments. Inclusion of BGS into the TMR did not affect the concentrations of P in feces (0.63, 0.61 and 0.66% P, DM), P digestibility, estimated using ADL as an internal

marker, nor was plasma inorganic P affected. In conclusion, up to 15% BGS was included in a TMR fed to late lactation cows without affecting performance. However, the inclusion of BGS into the TMR had no affect on P absorption as indicated by fecal P and plasma inorganic P.

Key Words: Bluegrass Straw, Phosphorus, Feces

T290 Scrotal circumference in performance tested bulls: Prediction of measures at 365 days of age from measures at 240 days of age. J. E. Decker*, P. Luna, A. M. Encinias, and M. G. Thomas, *New Mexico State University*, *Las Cruces*.

Bulls must achieve scrotal circumference (SC) of 30 cm by 365 days of age to pass a breeding soundness exam (BSE). At the Tucumcari Bull Test Station in New Mexico, from 1983 to 2006, SC was measured at the delivery of bulls and at the end of a 112-d test on 2514 bulls of 22 breeds. Bulls that had a final SC greater than 30 cm (n=2418) by 365 days of age had an initial SC of 25.3 ± 0.06 cm, and 96 bulls that had a final SC less than 30 cm had an initial SC of 21.8 ± 0.28 cm. Initial SC was measured at approximately 240 days of age and daily gain of SC was 0.08 ± 0.0005 cm. Objective of this research was to estimate a 240-d SC culling level (i.e., initial SC) for bulls to achieve 365-d SC of 30 cm. Associations between 240-d and 365-d SC were evaluated with correlation and multi-variance regression. The lower 95% confidence limit was plotted and probabilities of reaching 30 cm by 365 days of age were estimated for a minimum SC value (i.e., initial SC of a bull test). These probabilities were standardized and calculated using normal distribution. A correlation of 0.52 ($P < 0.01$) was detected between 240 and 365-d SC. Initial SC, year, sire and breed were significant ($P < 0.01$) sources of variation in a mixed prediction model of 365-d SC. Plotting of the lower 95% confidence limit of the predicted 365-d SC regression line suggested a 240-d SC of 22.5 cm as a culling level to achieve 365-d SC of 30 cm; whereas the probability estimated ($P < 0.01$) by standard-normal distribution revealed that 21 cm was needed to achieve 365-d SC of 30 cm. In these data, if a culling level of 21 cm was imposed for 240-d SC, 138 or 5.7% of the 2418 bulls achieving 30 cm by 365 days of age would have been unnecessarily culled, and 63 or 65.6% of the 96 bulls with SC less than 30 cm at 365 days of age would not have been culled. Herein, a limited number of bulls failed a BSE due to SC (n = 96; 3.8%). Because of moderate associations and the large percentage of bulls that would have been culled or selected incorrectly, results suggest that SC at 240 days of age is a weak predictor of SC at 365 days of age.

Key Words: Bulls, Scrotal Circumference, Prediction

T291 Estimation of no-return costs for different cattle identification systems in California. G. Caja*[1,2], F. Haque[2], J. W. Oltjen[2], L. J. Butler[2], J. L. Evans[3], and V. J. Velez[3], [1]*Universitat Autònoma de Barcelona*, *Bellaterra, Spain*, [2]*University of California*, *Davis, CA*, [3]*California Department of Food and Agriculture*, *Sacramento, CA*.

Cost of National Animal Identification System (NAIS) compliance at the producer level is a concern among livestock stakeholders in the US. The uncertain feelings expressed by stakeholders serve to frustrate and deter them from NAIS. Little information on cost values of different identification (ID) systems is currently available in the US and abroad, and complete and reliable estimations are required to evaluate their impact to the livestock industry across different segments. Changes in the price of devices and labor alter dramatically the estimated cost values for each ID system. A simulation model, based on a spreadsheet analysis of no-return costs for a Californian environment (UCD-CDFA Direct cost calculator, v. 2.2) was built up for different cattle scenarios (beef cow herd, 10 to 10,000 cows; feedlot, 10 to 100,000 steers; dairy cow herd, 100 to 10,000 cows). Conventional (plastic ear tag, hot and freeze branding, tattooing), electronic (ear tag, bolus, collar) and fingerprinting (retinal scan, DNA biopsying) ID systems were compared. Market prices of ID devices ($0 to $65) and reading equipment ($0 to $2,500); expected losses or unreadable rates for each ID device (0.5 to 15%); labor costs according to static or dynamic reading systems for $15/h salary; and, equipment amortization of 3 yr, were used. Total cost ($/animal and yr) of different ID systems varied markedly according to number of animals, number of readings per year and animal life span. Flat changes in total cost were calculated by sensitivity analysis for most ID systems when animals were >50. Case-study results for a herd of 500 beef cows, 7 yr life span, read 5 times/yr under static conditions, showed wide annual cost ranges according to ID system: conventional ($2.4 to $10.8/animal), electronic ($2.9 to $30.2/animal) and fingerprinting ($5.6 to $63.9/animal). Case-study values for a 500 steer growing-finishing operation, 2 yr life span, read 1 time/yr, were: conventional ($1.3 to $3.2/animal), electronic ($2.6 to $36.7/animal) and fingerprinting ($2.7 to $21.6/animal). Electronic ID systems were in many cases a cost competitive option.

Key Words: Animal Identification, Identification Cost, Cattle

T292 Analysis of birth weight, weaning weight, and pre-weaning gain in Simmental, Zebu and Simmental × Zebu calves on tropical pastures. J. C. Martinez-Gonzalez*[1], A. Azuara-Martinez[2], F. A. Lucero-Magana[1], E. G. Cienfuegos-Rivas[1], and S. P. Castillo-Rodriguez[1], [1]*Agronomia y Ciencias, Universidad Autonoma de Tamaulipas*, *Ciudad Victoria, Tamaulipas, Mexico*, [2]*Direccion General de Educacion Tecnologica Agropecuaria*, *Ciudad Victoria, Tamaulipas, Mexico*.

The productive performance of pure bred Simmental, Zebu and Simmental × Zebu calves were evaluated by analyzing 947 beef cattle records with birth weight (BW), weaning weight adjusted to 205d (WW) and pre-weaning gain (PWG) data. The climate of the region is tropical sub-humid with an average annual temperature and precipitation of 23.6°C and 935.1 mm respectively. Cows were fed mainly on pasture with occasional supplementation in the critical months of the year. Calves were weighed at birth and at weaning (average weaning age 205 days). The data were analyzed by general linear models procedures, using a fixed effect model which included the effects of genotype, year and birth season, sex of the calf and parity number of cow on BW, WW and PWG. The general means ± standard error for BW, WW and PWG were 35.18 ± 6.63, 193.91 ± 38.13 and 0.772 ± 0.179 kg, respectively. The year of birth and parity number affected (P<0.01) BW, WW and PWG. Birth season was an important source of variation (P<0.05) on WW and PWG. Genotype was affected (P<0.01) WW and PWG. The pure bred Simmental calves showed the lighter weights. It was concluded that, Simmental × Zebu calves can be an alternative for beef cattle production in tropical areas.

Key Words: Beff Cattle, Simmental, Weight

T293 Economic strategies for stocking rate and supplementation of stockers grazing rye-ryegrass pastures. F. M. Rouquette, Jr.*[1] and L. Ortega[2], [1]*Texas A&M University System Agricultural Research & Extension Center*, *Overton*, [2]*Agronomy Department, University of Zulia, Venezuela*, *Zulia, Venezuela*.

Increasing stocking rates to maximize gain per unit land area, and use of supplements to substitute for forage availability and increase ADG are management strategies used by stocker operators to increase economic return. The objective of this stocking rate (SR) x supplement (SUP) study was to quantify ADG and gain per ha as a database for assessing economic returns with variable input costs of fertilizer, supplement, and purchase-selling price of stocker cattle grazing ′Maton′ rye and ′TAM-90′ annual ryegrass. Two pasture replicates of 3.7 (LO), 5.2 (ME), and 7.2 (HI) hd/ha (270 kg initial BW/hd) received a daily, hand-fed ration of 98% cracked corn plus Rumensin 80 at 0 (PAS), 0.4% BW (.4 SUP), and 0.8% BW (.8 SUP). The 150-day ADG ranged from 1.5 kg/d for stockers at LO SR plus .8 SUP to .5 kg/d for stockers at HI SR and PAS (P<.01), with respective gain/ha at 1130 kg/ha and 560 kg/ha. Based on actual input costs and animal prices at time of the winter pasture grazing in 2004-2005, respective animal plus pasture costs/kg gain for LO, ME, and HI SR were $.68, $.79, and $1.39/kg for PAS; $.73, $.73, and $.99/kg for .4 SUP; and $.84, $.77, and $1.06/kg for .8 SUP. With initial purchase price of $2.77/kg for steers and $2.53/kg for heifers, the break-even selling price ranged from about $1.83/kg on all LO SR regardless of SUP to $2.10/kg on all HI SR plus SUP and $2.38/kg on HI SR without SUP. The net returns ranged from $622/ha for ME SR and .8 SUP to $-131/ha for HI SR and PAS. The differential returns/ha among SR and SUP strategies showed that an additional $753/ha was obtained by decreasing SR from HI to ME plus SUP at .8% BW. Using .8 SUP at HI SR increased ADG by .45 kg/hd, over PAS, and showed an additional $385/ha advantage due to SUP. Increasing costs of nitrogen fertilizer and corn reduced net returns/ha but had less effect than reduced animal prices and reduced purchase-sell margin.

Key Words: Ryegrass, Stocking Rate, Supplementation

T294 Development of a model for noninvasive evaluation of energy profiles in beef cows. J. F. Odhiambo*, E. E. Felton, R. Helmondollar, J. Y. Pritchard, P. I. Osborne, and R. A. Dailey, *West Virginia University*, *Morgantown*.

Body condition scores (BCS) indicate body energy reserves. However, variations among scorers and regional scoring systems prompted examination of utility of other non-invasive techniques. Spring-calving cross-bred Angus and Hereford cows (n = 150) were evaluated using body weight measurements, BCS, and ribfat and rumpfat ultrasonic scans. Cows were assigned randomly within age to two treatments, early or normal weaning 45 days apart to provide a range of energy states. Data were collected at early weaning, normal weaning, precalving, postcalving and breeding using an electronic weighing system and BCS evaluation by a single observer. Images were collected by positioning the 5.0 MHz transducer directly above the interface of the Biceps femoris and Gluteus medius (rumpfat) and at 75% of the distance from the medial to lateral end of the 12th to 13th intercostal space (ribfat). Data were examined by repeated measures for a split plot design using PROC MIXED procedures of SAS with treatment, age, and treatment x age in the main plot and period and its interactions in the subplot. Although ribfat (P = 0.001) and rumpfat (P = 0.01) differed between treatments, cow weight and BCS did not. Age was linearly related to weight (P = 0.0001), BCS (P = 0.001), ribfat (P = 0.002), and rumpfat (P = 0.001). Age x treatment effects were significant (P = 0.04, 0.001, 0.005 and 0.02 for weight, BCS, ribfat and rumpfat, respectively). Age x treatment x period effect was highly significant for rumpfat (P = 0.0001) followed by ribfat (P = 0.01) and weight (P = 0.05) but not BCS (P = 0.5). Rumpfat was highly correlated to ribfat (r = 0.83), to BCS (r = 0.65), to weight (r = 0.60) and fairly correlated to age, r = 0.27 (P = 0.0001). In conclusion, rumpfat provided a more sensitive measure for energy profiles than cow weight, while BCS was least effective. Because rumpfat and ribfat were highly correlated, assessing effects of both variables was counterproductive in evaluating energy status.

Key Words: BCS, Weight, Rumpfat

Ruminant Nutrition II

T295 Effects of waste products from plant materials on *in vitro* rumen fermentation. D. Tedesco*, S. Stella, L. Garavaglia, C. Barbieri, and S. Galletti, *University of Milan*, *Italy*.

The industrial processing of fruits, vegetables and the extraction of phyto-therapeutic compounds from plants produce many tons of organic wastes that could include valuable compounds (e.g. pectin, poly-phenoles, flavonoids). The objectives of the present study were to evaluate specific post-processing derivative waste products from plant residues (SAFEWASTES, EU project n. 513949) on rumen microbial fermentation by batch incubator system. The in vitro batch culture was carried out with rumen fluid withdrawn from three rumen-fistulated non-lactating dairy cows. The rumen fluid was added to a mineral salt buffer, mixed in a bottle warmed at 39°C, purged with anaerobic grade N2/CO2 (80/20, v/v) and standardized at pH 6.8 ± 0.1. 100 mL of solution were placed in glass bottles supplied with a substrate for microbial growth (0.8 g/100mL alfalfa hay and 0.2 g/100mL corn meal). In this study, a total of 52 SAFEWASTES by-products were tested at three different concentrations. Each test was evaluated in duplicate. The bottles were incubated in a water shaking bath at 39°C for 24 h. The pH was determined at 0, 4, 9, 24h of incubation. At 0 and 9h of incubation the production of VFA and of ammonia N were determined. Total Bacterial Count (TBC) was evaluated at 0h and after 24h of incubation. Statistical analysis was performed using PROC MIXED of SAS. None of the tested substances negatively affected rumen microbial fermentation. TBC value remained stable after 24h of incubation. Among the 52 tested substances, one caused a significative decrease (P<0.05) in ammonia N production in all the concentrations tested. Considering VFA production, an increase in acetic acid yield (P<0.05) was observed following incubation with two SAFEWASTES by-products. These *in vitro* results permitted to identify the substances that will be further evaluated in the *in vivo* trials. Furthermore, if positive physiological functions will be evidenced in other studies (e.g. as antinflammatory, immunostimulant), these substances could potentially have a use as feed additives.

Key Words: Waste Products From Plant Materials, VFA, Rumen Fermentation

T296 Rumen degradation ratios: comparison of frost-damaged wheat with normal wheat. P. Yu* and V. Racz, *University of Saskatchewan*, *Saskatoon, SK, Canada*.

In this study, rumen degradation ratios of structural carbohydrates (SC), non-structural carbohydrate (starch: ST) and crude protein (CP) in the frost-damaged wheat were determined in dairy cows, using Tamminga Rumen Degradation Ratio System. The rumen degradation ratios were compared with the optimum ratio range. The overall test weight losses of the frost-damaged wheat were around 24%. The results showed that: 1) Rumen available insoluble N (EN), SC (ESC) and ST (EST) were 14 vs. 11 (P<0.05), 133 vs. 254 (P<0.05), and 441 vs. 326 g kg-1 DM (P<0.05), respectively, between the normal and frost-damaged wheat; 2) Rumen available soluble N (SN), SC (SSC) and ST (SST) were 3 vs. 6 (P<0.05), 0 vs. 0, and 86 vs. 84 g kg-1 DM (P>0.05), respectively; 3) Total rumen available N (FN), SC (FSC) and ST (FST) were 17 vs. 17 (P>0.05), 139 vs. 254 (P<0.05), and 527 vs. 410 g kg-1 DM (P<0.05), respectively. The degradation ratios were calculated between the total rumen available N and carbohydrates (FN/FCHO), rumen available soluble N and carbohydrates (SN/SCHO), and rumen available insoluble N and carbohydrates (EN/ECHO). The ratios showed a significant difference between the normal and frost-damaged wheat in EN/ECHO ratio (24 vs. 18 g kg -1, P<0.05). The frost-damaged wheat had numerically higher ratio of SN/SCHO (89 vs. 35 g kg-1, P>0.05) and similar FN/FCHO (25 vs. 25 g kg-1) than the normal wheat. These results indicated that the normal and frost-damaged wheat differed in degradation utilization, however, both exhibited an optimal rumen fermentation ratio (optimum: FN/FCHO = 25 to 33 g N kg -1 CHO).

Key Words: Optimal Rumen Fermentation, Degradation Ratio, Frost-Damaged Wheat

T297 Available protein, structural and non-structural carbohydrates: comparison of frost-damaged wheat with normal wheat. P. Yu* and V. Racz, *University of Saskatchewan*, *Saskatoon, SK, Canada*.

In 2004, more than 50% of wheat was frost-damaged, rendering millions of tons of wheat unsuitable for human consumption. So far, little systematic research has been conducted to determine the magnitude of the differences in nutritive value between frost-damaged and normal wheat. In this study, rumen degradation characteristics of structural carbohydrates (SC), non-structural carbohydrate (starch: ST) and crude protein (CP) in the frost-damaged wheat were determined in dairy cows. Measured ruminal degradation characteristics were soluble fraction (S: ST and CP), undegradable fraction (U: SC and CP), lag time (T0: SC and CP) and rate of degradation (Kd: SC, ST and CP) of the insoluble but degradable fraction (D: SC, ST and CP). The overall test weight losses of the frost-damaged wheat were around 24%. The measured characteristics showed significant differences between the normal and frost-damaged wheat. For protein, the frost-damaged wheat was lower (P<0.05) in D (612 vs. 878 g kg-1 CP) and higher (P<0.05) in S (263 vs. 122 g kg-1 CP) and U (125 vs. 0 g kg-1 CP). It was also higher in total available soluble N (6 vs. 3 g kg-1 DM), lower in total available insoluble N (11 vs. 14 g kg-1 DM) than the normal wheat samples. No significant differences were found on T0, Kd, and total available N between the normal and frost-damaged wheat. For non-structural carbohydrate, the frost-damaged wheat tended to be higher (P<0.10) in Kd of ST (45.11 vs. 32.39 % h-1), lower (P<0.05) in rumen available insoluble ST (326 vs. 441 g kg-1 DM), and total rumen available ST (410 vs. 527 g kg-1 DM). There is no difference in rumen available soluble ST (average 85 g kg-1 DM). For structural carbohydrate, the frost-damaged wheat contained higher potentially degradable SC (297 vs. 180 g kg-1 DM, P<0.10), rumen available insoluble SC (254 vs. 133 g kg-1 DM, P<0.05) and total rumen available SC (254 vs. 139 g kg-1 DM). The D, U, Kd and T0 were similar (P>0.05). The results showed that the normal and frost-damaged wheat showed different degradation kinetics, which indicates different nutrient availability.

Key Words: Degradation Kinetic, Frost-damaged Wheat, Protein/ Carbohydrate

T298 Modelling nutrient supply to dairy cattle from normal and frozen sheat: Comparison of the National Research Council-2001 model with the DVE/OEB system. P. Yu*, R. Racz, and J. McKinnon, *University of Saskatchewan*, *Saskatoon, SK, Canada*.

The objective of this study was to 1) predict nutrient supply of frozen wheat to dairy cattle in comparison with normal wheat, and 2) compare the DVE/OEB system (DVE = truly absorbed protein in the small intestine; OEB = degraded protein balance) and the NRC-2001 model in the prediction of nutrient supply to dairy cows from different types of frozen wheat and normal wheat. Comparisons were made in terms of (1) ruminally synthesized microbial CP, (2) endogenous protein, (3) rumen undegraded feed protein, (4) truly absorbed protein in the small intestine, and (5) degraded protein balance. The results showed that the predicted values from the DVE/OEB system and the NRC-2001 model had significant correlations with high R (> 0.90) values. However, using the DVE/OEB system, the overall average microbial protein supply was 13.7% higher (65.2 vs. 56.3 g/kg DM), the digestible rumen undegraded feed protein was 10.0% higher (43.4 vs. 39.0 g/kg DM), endogenous protein was 65% higher (12.3 vs. 4.3 g/kgDM) than that predicted by the NRC-2001 model. However, the truly absorbed protein in the small intestine was similar (96.2 vs. 99.6 g/kg). The difference was also found in the prediction of the degraded protein balances, which was 78% higher based on data from the NRC-2001 model (-16.7 vs. -3.7 g/kg DM). These differences are due to considerably different factors used in calculations in the two models, although both are based on similar principles. This indicates that a further refinement is needed for a modern protein evaluation and prediction system. In addition, this study showed that the normal wheat had no difference in DVE and OEB values, but significant difference in metabolizable protein value (108.1 vs. 95 g/kg DM, P<0.05)

Key Words: Modelling Nutrient supply, Dairy Cows, Frozen Wheat

T299 Feed values of barley varieties could be determined using in vitro gas production technique. M. Rinne[1], S. Ahvenjärvi[1], M. Holma[2], and P. Huhtanen*[1,3], [1]*MTT Agrifood Reserach Finland*, *Jokioinen, Finland*, [2]*RehuRaisio Ltd.*, *Raisio, Finland*, [3]*Cornell University*, *Cornell, NY*.

Fiber (NDF) from cereal grains can in some feeding situations form a considerable proportion of ruminant diets. The in vitro gas production technique provides a method to study separately digestion kinetics of concentrate NDF and cell solubles, which is not achievable in vivo.

Information of NDF digestion is important as it is more variable than digestion of cell solubles. Fourteen barley grain samples representing different varieties grown in the Nordic countries were ground and ND solution was used to extract cell solubles. Indigestible NDF was estimated by a 12 d ruminal in situ incubation (nylon bag pore size 17 μm). In vitro gas production of the intact samples and the NDF residues were determined for 72 h with a 15 min. measurement interval in triplicate runs. The gas curve for cell solubles was calculated by subtraction. The two-pool Gompertz function was fitted to the gas curves, and digestibility of the potentially digestible NDF (pdNDF) was estimated using a dynamic rumen simulation model. The first-order rate of digestion was calculated from the pdNDF digestibility. Concentrations of NDF and iNDF of the samples were 198 (s.d. 22.6) and 34 (s.d. 8.1) g/kg DM, respectively. The rate of digestion of cell solubles was faster than that of digestible fiber [0.143 (s.d. 0.0090) vs. 0.075 (s.d. 0.0097) per h]. The digestibility of pdNDF was on average 0.761 (s.d. 0.0291) and that of cell solubles 0.884 (s.d. 0.0090). There were significant differences between the varieties and especially a hulless variety had a fast rate of pdNDF digestion. The concentration of NDF was negatively correlated to the rate of pdNDF (r = -0.562) and calculated ME concentration (r = -0.867) of the samples. In vitro gas production technique shows potential for studying the differences in digestion properties and feeding value of grain samples.

Key Words: Rate of Digestion, Indigestible Fiber, Cell Solubles

T300 Effect of an exogenous fibrolytic enzyme on in vivo digestibility of King grass hay. J. H. Avellaneda-Cevallos*[1], G. Quintana-Zamora[1], F. Espinoza-Torrico[1], O. Montañez-Valdez[2], I. Espinoza-Guerra[1], R. Luna-Murillo[1], S. González-Muñoz[3], and J. Tuárez-Cobeña[1], [1]*Facultad de Ciencias Pecuarias, Unidad de Investigación Cientifica y Tecnológica, Universidad Técnica Estatal de Quevedo*, *Quevedo, Los Rios, Ecuador*, [2]*Divisíon de Bienestar y Desarrollo Regional, Departamento de Desarrollo Regional, Universidad de Guadalajara*, *Ciudad Guzmán, Municipio de Zapotlán, Jalisco, México*, [3]*Colegio de Postgraduados*, *Texcoco, Estado de México, México*.

The effect of a enzymatic fibrolytic exogenous compound in the digestibility in vivo (DIV), and nitrogen balance in sheep fed with hay of King grass (Pennisetum hydridum) cut at 35 and 70 days was evaluated. Four Pelibuey × Chatadin sheep were used (35±4 Kg BW) in a 4× 4 Latin square design with a 2×2 factorial treatment arrangement (two cutting dates and two levels of enzymes; 0 and 1 g of Fibrozyme/Kg of DM). Four treatments were established: T1: King grass cut at 35 d with enzyme; T2: King grass cut at 35 d without enzyme; T3: King grass cut at 70 d with enzyme; T4: King grass cut at 70 d without enzyme. The DIV of DM (T1: 67.04a, T2:68.25a, T3: 65.08a, T4: 64.33; P>0.05; SEM=2.59), OM (T1: 72.13a, T2: 75.01a, T3: 69.04b, T4: 68.38b; P <0.05; SEM= 1.31) and protein (T1: 68.06a, T2: 69.59a, T3: 58.66b, T4: 58.84b; P<0.05; SEM= 2.22) was substantial on the hay cut at 35 d compared to the hay cut at 70 d, which was not influenced by the enzyme fibrolytic exogenous compound. The retention of nitrogen was superior (P>0.05) for the 35 vs 70 d hay without being influenced by the enzyme compound. In conclusion the enzyme fibrous exogenous do not affect the digestion of the nutrients in the King grass hay.

Key Words: King Grass Hay, Fibrolytic Enzymes, Digestibility

T301 Effects of Bovazyme WP™ on microbial efficiency and metabolism in continuous culture of rumen contents. B. P. House*, L. Holden, and G. A. Varga, *The Pennsylvania State University*, *University Park*.

A continuous culture study was conducted to evaluate the effect of BovaZyme™ (BVZ, York Ag Products, Inc.), a concentrated source of enzymes and other fermentation enhancers, on ruminal microbial metabolism. Diets were formulated to be similar in nutrient composition and consisted of a basal diet without BVZ (control) and a diet with BVZ, equivalent to 2.5g/head/day. Continuous culture fermenters were fed 100g DM/d and conditions included a liquid dilution rate of 13%/hr, solids dilution rate of 4.55%/hr, and a solids retention time of 22 hr. The BVZ significantly increased ruminal digestibility of acid detergent fiber by 16.2% (P=0.05). Though not significant, neutral detergent fiber digestibility numerically increased by 14.6% for BVZ compared to the control. Rumen by-pass nitrogen was decreased 12% (P=0.05), while crude protein digestibility was increased by 9% (P=0.04) for fermenters provided BVZ. Microbial nitrogen (N) production/d of the BVZ diet was 12% higher (P=.04) than the control. There was no change in conversion of feed N to microbial N, however, volatile fatty acids (VFA) produced/unit of microbial N was lower (P=.04) in the BVZ diet, indicating a tendency to partition more feed organic matter to microbes rather than VFA. Total VFA production was not changed due to BVZ, but increases were observed in acetate and butyrate production along with a decrease in propionate production for fermenters provided BVZ compared to the control. As a result, the acetate-propionate ratio increased from 1.60 to 2.14 (P=.09). Comparing changes in pH over time between treatments illustrated that BVZ attenuated a rapid rise in pH 2-3 hours post feeding compared to the control resulting in a more continuous supply of nutrients. Addition of BVZ to the diet resulted in improved rate and extent of fiber digestibility, greater microbial growth and an improved VFA profile compared to the control.

Key Words: Continuous Culture, Feed Enzyme Additive

T302 Effects of yeast and type of starch on pH fluctuation, nutrient digestion and microbial fermentation in a dual flow continuous culture system. D. Moya*, S. Calsamiglia, A. Ferret, and M. C. Fuentes, *Universitat Autonoma de Barcelona*, *Barcelona, Spain*.

Eight 1320-mL dual flow continuous culture fermenters were used in a 2 × 2 factorial design in two replicated periods of 9 d (6 for adaptation and 3 for sampling) to determine the effect of live yeast and type of starch on rumen microbial fermentation and nutrient digestibility. Main factors were live yeast (Saccharomyces cerevisiae CNCM I-1077,Levucell®SC): no yeast (NY) vs 1.3 × 106 CFU of yeast/g of diet (Y); and type of starch: slow degradable (S, a 55% ground corn diet, 17.2% CP, 27.8% NDF) vs rapidly degradable (R, a 89.2% barley diet, 16.1% CP, 16.1% NDF). All fermenters were fed 80 g DM/day of a 10 to 90 forage to concentrate diet in three equal amounts along the day. Fermentation temperature (38.5°C) and liquid (12%/h) and solid (5%/h) dilution rates were maintained constant. The pH was allowed to fluctuate with an upper (6.6) and lower (5.5) limit controlled by infusion of 3 N HCl or 5 N NaOH. Effluent samples were taken from a composite of the three sampling days, and bacteria were isolated from fermenter flasks on the last day of each period for chemical analysis. Treatment R increased (P < 0.01) the true digestion of DM and OM,

and decreased (P < 0.01) the NDF and ADF digestion. Ammonia N flow and CP degradation was higher (P < 0.05) and dietary N flow was lower (P < 0.01) in R compared with S. Treatment Y decreased ammonia (P < 0.05) and dietary (P < 0.10) N flow, and increased (P < 0.05) bacterial N flow, CP degradation (P < 0.10) and the efficiency of microbial protein synthesis (P < 0.10). Treatment R reduced the min to minimum pH (P < 0.05) and increased the area under pH 6.0 (P < 0.01). Treatment Y increased the min until minimum pH in the two types of starch and reduced the area under pH 6.0 in R treatment (P < 0.05). Results from the comparison between R and S were expected. Treatment Y improved N metabolism and reduced the drop of pH after feeding a rapidly degradable starch diet.

Key Words: Yeast, Starch, Microbial Fermentation

T303 Screening for the effects of commercial additives at two pH levels on in vitro rumen microbial fermentation of a high-concentrate beef cattle diet. D. Moya*, S. Calsamiglia, A. Ferret, and J. I. Fandiño, *Universitat Autonoma de Barcelona*, *Barcelona, Spain*.

Ten commercial additives were screened at 3 doses (low, medium and high) and 2 levels of pH (7.0 and 6.0) in a duplicate 10 × 3 × 2 factorial arrangement of treatments to determine their effects on rumen microbial fermentation profile. Treatments were: two sources of tannins (TAN1 and TAN2), three sources of saponins (SAP1, SAP2 and SAP3), two sources of yeast (YEA1 and YEA2), rice fatty acids (RFA), garlic powder (GAR) and one source of natural plant alcaloids (sanguinarine and chelerytrine, NPA). Treatments were tested in triplicate in two consecutive periods in batch cultures. Ruminal fluid was taken from two feedlot steers, mixed with an equal volume of artificial saliva and adjusted to pH 7.0 or 6.0 with 3 N HCl and 5 N NaOH. All tubes were supplied with 0.5 g of DM of a 10 to 90 forage to concentrate diet (16.6% CP, 22.0% NDF, 12.4% ADF). Tubes were filled with 50 ml of fluid, infused with CO2 to remove O2, stamped with gas-release rubber stoppers, and incubated for 24 h at 39°C. Samples were collected for ammonia N and volatile fatty acid (VFA) determinations. Differences were declared at P < 0.05. When pH was 7.0, TAN1, TAN2, SAP2, SAP3 and NPA increased total VFA concentration; TAN1, TAN2, SAP2, YEA1, YEA2, GAR and NPA increased the acetate to propionate ratio; and TAN1 and TAN2 reduced ammonia N concentration, whereas SAP2 and NPA increased it. In contrast, when pH was 6.0, TAN1 reduced total VFA; TAN2, SAP1 and SAP3 increased the acetate to propionate ratio; and TAN1, TAN2 and YEA1 reduced ammonia N concentration, whereas NPA increased it. Results indicate that the effects of commercial additives on rumen fermentation in beef cattle diets may differ depending on rumen pH. When pH was 7.0 most of commercial additives tested had more activity. The increase in total VFA concentration and the reduction in ammonia N concentration observed with tannins suggest that they may be useful in modifying rumen microbial fermentation.

Key Words: Rumen pH, Fermentation, Commercial Additives

T304 Effect of fibrolytic enzyme application to diets differing in concentrate proportion on the performance of lactating dairy cattle. K. G. Arriola*, A. T. Adesogan, S. C. Kim, T. W. Kang, C. M. Huisden, and C. R. Staples, *University of Florida*, *Gainesville*.

This study examined the effect of dietary application of a fibrolytic enzyme preparation containing xylanase, cellulase and esterase activities (Dyadic International Inc., Jupiter, FL) in lactating dairy cows consuming diets with high (48% of dietary DM) or low (33% of dietary DM) proportions of concentrate. Sixty lactating Holstein cows were classified according to milk production and randomly assigned at 22 DIM to four treatment groups arranged in a 2 x 2 factorial design. The trial lasted for 77 d, the first 14 d were used for adaptation to diets and the last 63 d for measurements. Dietary treatments included the following: 1) Low concentrate diet (LC); 2) LC plus enzyme (LCE); 3) High concentrate diet (HC); 4) HC plus enzyme (HCE). The enzyme was sprayed at a rate of 3.4 mg/g of DM on the TMR daily. Four ruminally-fistulated cows were used to measure dietary effects on the ruminal environment. Enzyme application did not affect DM intake (DMI) (P > 0.05) but tended to increase milk yield (P = 0.06; 32.8 vs. 34.7 kg/d) and therefore increased the efficiency of milk production (1.36 vs. 1.55 kg milk/kg DMI; P = 0.008). Increasing the concentrate level increased (P < 0.05) DMI (22.0 vs. 25.5 kg/d), milk yield (32.5 vs. 35.0 kg/d), and milk protein yield (0.92 vs. 1.01 kg/d), but reduced ruminal pH (P < 0.01; 6.31 vs. 6.06) and tended to reduce the efficiency of milk production (P = 0.108; 1.51 vs. 1.40 kg milk/kg DMI). Compared to cows fed HC, those fed LCE had lower DMI (P = 0.009; 21.2 vs. 25.6 kg/d), greater ruminal pH (P = 0.01; 6.36 vs. 6.10) and similar milk yield (P = 0.693; 33.2+1.0 kg/d). Consequently the efficiency of milk production was greater in cows fed the LCE diet than those fed the HC diet (P = 0.003; 1.62 vs. 1.32 kg milk/kg DMI). Therefore this mixture of fibrolytic enzymes increased the amount and efficiency of milk production by dairy cows.

Key Words: Fibrolytic Enzyme, Milk Production, Esterase

T305 Effect of a ruminal buffer and an amilolytic enzymes mixture added to a sorghum grain diet on finishing Criollo lambs. H. A. Lee–Rangel[1], G. D. Mendoza–Martínez[2], S. S. González*[1], G. Ramírez–Valverde[1], and J. H. Avellaneda–Cevallos[3], [1]*Colegio de Postgraduados*, *Montecillo, Edo. México, México*, [2]*UAM Xochimilco*, *México D.F.*, [3]*Universidad Técnica Estatal de Quevedo*, *Quevedo, Ecuador*.

The objective of this trial was to determine the effect of an amilolytic enzymes mixture (enzyme) from *Aspergillus niger* (Glucozime® L-400, Takaterm) and *Bacillus lincheniformis* (α–1, 4 D-glucan hydrolase) (ENMEX, México) plus a buffer (Acid buf®) on finishing lambs performance. The enzyme was sprinkled on ground sorghum (2.6 g/kg DM) and the buffer was added (0.85% DM) to the diet which contained 72% sorghum, 10% corn stover, 9% cane molasses and 7% SBM. The experiment lasted 50 days and treatments (T) were: T1, control (no enzyme or buffer); T2, enzyme; T3, buffer; T4, enzyme + buffer. The experimental design was completely randomized and data were analyzed using PROC MIXED (SAS) with initial BW as a covariable. The experimental units were 32 Criollo lambs (25 ± 2.5 kg initial BW) housed in individual metabolic cages. There were no significant differences (Tukey; P≥0.01) for ADG (264.7, 262.7, 282.5, 284.5 ± 0.02 g/d), DMI (1124.7, 1127.5, 1200.1, 1216.9 ± 65.8 g/d), and feed conversion (4.75, 4.39, 5.3, 4.65 ± 0.47). Therefore, addition of an amilolytic enzymes mixtures plus a buffer did not change performance of finishing Criollo lambs fed a sorghum grain diet.

Key Words: Amilolytic Enzymes, Buffer, Criollo Lambs

T306 Effects of exogenous amylase from Bacillus licheniformis on sheep performance and starch digestion. M. M. Crosby[1], G. D. Mendoza*[2], L. M. Melgoza[2], J. R. Barcena[1], and F. X. Plata[2], [1]*Colegio de Postgraduados*, *Montecillo, Mexico, Mexico*, [2]*Universidad Autonoma Metropolitana Xochimilco*, *Mexico, D.F., Mexico*.

An experiment was conducted to determine the effects of exogenous amylase dose in sheep performance and starch digestion and with a sorghum based diet (68% of the diet). Thirty-six sheep (Creole × Suffolk, 21.66 ± 6.5 kg BW) were assigned the following doses of amylase from B. Licheniformis (g enzyme /kg dry matter of grain): 0.0, 0.6, 1.2, 1.8, 2.4 and 3.0. In vivo starch digestion was not different when dose was increased (94.8, 97.4, 96.0, 95.4, 96.0, 96.8%). No differences were detected ($P \geq 0.05$) in daily gain (215, 206, 223, 220, 222, 209 g/d) among treatments for the increasing doses (0 to 3.0 g respectively). Feed conversion was not affected by enzyme dose (4.54, 4.34, 4.47, 4.43,, 4.38 and 4.47 for the same doses respectively). Sheep performance and starch digestion were not improved with the exogenous amylolytic enzyme.

Key Words: Starch, Digestion, Enzyme

T307 Effect of feeding Fermenten® on rumen fermentation in cows fed different concentrations of sucrose. G. B. Penner*[1], L. L. Guan[1], K. A. Beauchemin[2], and M. Oba[1], [1]*University of Alberta*, *Edmonton, Alberta, Canada*, [2]*Agriculture and Agri-Food Canada*, *Lethbridge, Alberta, Canada*.

A study was conducted to determine the effect of feeding Fermenten® on rumen fermentation and microbial populations in lactating Holstein cows fed diets differing in sucrose concentration. We hypothesized that Fermenten® would decrease propionate concentration in ruminal fluid, and increase rumen ammonia production; however, these effects would be altered by dietary sucrose concentration. Eight multiparous ruminally cannulated cows (163 ± 55 DIM) were used in a replicated 4 × 4 Latin square design with 21-d periods. Treatments were arranged as a 2 × 2 factorial: Fermenten® inclusion (FERM vs. control) and dietary sucrose concentration (6.5 vs. 2.0% DM). Diets were formulated to contain 18.7% CP, 23.2 % forage NDF and were offered ad libitum. Cracked corn replaced sucrose for the low sugar diets, and urea and soybean meal replaced Fermenten® in the control diets. Ruminal pH was measured for 72 h continuously using the Lethbridge Research Centre Ruminal pH System. No detectable differences were observed for microbial diversity using PCR-DGGE analysis. Ruminal pH parameters were not affected by treatment with mean pH averaging 6.23. Although, FERM did not alter individual VFA concentrations, there tended ($P < 0.10$) to be interactions between FERM and sucrose for propionate and acetate:propionate ratio. For high sucrose diets, FERM tended to increase propionate concentration (21.5 vs. 20.4 % of total VFA) and decrease the acetate:propionate ratio (2.82 vs. 3.01), whereas for low sucrose diets, FERM tended to decrease propionate concentration (20.9 vs. 21.8 % of total VFA) and increase the acetate:propionate ratio (2.80 vs. 2.95). FERM inclusion increased ($P < 0.01$) ruminal ammonia concentration (18.4 vs. 15.7 mg/dl) over the control. These data indicate that Fermenten® affects N metabolism in the rumen regardless of dietary sucrose concentration. However, the effect of Fermenten® on the ruminal VFA profile is dependent on the concentration of sucrose in the diet.

Key Words: Fermentent, Sucrose, Rumen Fermentation

T308 Influence of encapsulation of ascorbic acid to fermentation by rumen bacteria, in vitro. J. E. Garrett*[1], G. Oenga[1], A. Tayal[1], and T. M. Webster[2], [1]*Balchem Corporation*, *New Hampton, NY*, [2]*West Virginia University*, *Morgantown*.

The feeding of ascorbic acid to ruminants has been difficult due to the destructive nature of the rumen bacteria to this easily oxidized compound. The objective of this study was to evaluate the stability of ascorbic acid (AA) to rumen bacterial fermentation in vitro when protected by a lipid encapsulation. Raw ascorbic acid (RAA) was compared with two different encapsulation methods, rumen protected ascorbic acid (RPAA, Vitashure C, Balchem Corporation), and rumen protected ascorbic acid with a high melting point (RPAA-HM, Vitashure 140, Balchem Corporation). Individual samples of each ascorbic acid type were incubated in 50 ml test tubes in triplicate following a modified method of Tilley and Terry (1963) for 30 min, 6 h, 12 h and 24 h. Each tube contained .3 g of equal parts corn and SBM with .01 g of equivalent AA. Blanks were run for naturally occurring AA in the feeds. Each sample was freeze dried after incubation and held for analysis. Blanks and RAA were water extracted to obtain any residual AA. Chloroform was used to dissolve the lipid coating. Distilled water, centrifugation and filtration were used to obtain residual AA from the encapsulated samples. All samples were then immediately analyzed by HPLC for AA. RAA had significantly less ($P<.05$) recovery after 30 min than either RPAA or RPAA-HM (37.3 vs 65.3 and 79.0%, respectively). After 30 min, RAA had 3.05% or less of the initial AA at the other incubation times which was significantly less ($P<.05$) than either encapsulated product. Recovery of AA from RPAA and RPAA-HM was not significantly different ($P>.05$) from each other at the 6, 12 and 24 h incubations, averaging from 43 to 65% recovery. RPAA-HM did have numerically higher recoveries of AA for all time points measured. RAA is extensively degraded by rumen bacteria in less than 6 h. Both encapsulation methods proved to be an effective means of protecting 50% or more of the AA exposed to rumen bacterial fermentation through 24 h.

Key Words: Ascorbic Acid, Encapsulation, Rumen Bacteria

T309 Quantification of Streptococcus bovis and Megasphaera elsdenii in ruminal fluid of dairy cows and beef heifers by real time PCR technique. M. Blanch*, S. Calsamiglia, and A. Castello, *Universitat Autonoma de Barcelona*, *Spain*.

The objective of this study was to develop quantitative real time PCR (qRT-PCR) assays to: a) detect and quantify two rumen bacteria involved in ruminal acidosis: Streptococcus bovis and Megasphaera elsdenii (Exp. 1); and b) determine the variability due to animal, day and hour of sampling (Exp. 2). In Exp. 1, the assays were evaluated using DNA from pure cultures and rumen fluid samples from Exp. 2. The efficiency of the real time PCR assay was 88% and 99% for S. bovis and M. elsdenii, respectively. The specificity of the two primer-probe combinations was confirmed using different bacterial pure cultures as negative controls. In Exp. 2, a comparative study of S. bovis and M. elsdenii rumen populations was conducted using 4 cows and 4 beef heifers (696 ± 94 and 221 ± 17 kg BW, respectively). Cows were fed a 69:31 forage to concentrate total mixed ration ad libitum (15.6% CP, 35.4% NDF) and 3 kg of concentrate (25.8% CP, 21.7% NDF), and beef heifers were fed a 10:90 forage to concentrate ratio diet (15.7% CP, 22.3% NDF). During 5 consecutive days, samples of ruminal fluid were collected at 0, 4, 8 and 12 h after the morning

feeding. S. bovis was 145-fold higher in cows than in heifers. M. elsdenii was 13-fold lower in cows than in heifers. The S. bovis:M. elsdenii ratio was not associated with changes in ruminal pH, because in spite of observing different ratios between heifers and cows (0.83 and 12.3, respectively), their pH was similar (averaged 6.26 ± 0.305). The coefficients of variation were large and always higher in heifers than in cows (from 45.2% to 156.7% in heifers, and from 25.0% to 94.8% in cows), and differed depending on the factor. In heifers, the most variable factor was animal, followed by day and hour. In cows, the factor with the highest variation was day, followed by hour and animal. The qRT-PCR may become a powerful tool to study changes in rumen microbial populations associated to dietary treatments.

Key Words: Rumen Acidosis, Streptococcus Bovis, Megasphaera Elsdenii

T310 The effect of heat stress on rumen microbial composition analyzed by sequence-specific rRNA cleavage method. Y. Uyeno*[1,3], Y. Sekiguchi[1], K. Tajima[2], A. Takenaka[2], M. Kurihara[2], and Y. Kamagata[1], [1]*National Institute of Advanced Industrial Science and Technology*, *Tsukuba, Japan*, [2]*National Institute of Livestock and Grassland Science*, *Tsukuba, Japan*, [3]*National Federation of Dairy Co-operative Associations*, *Tokyo, Japan*.

It is recognized that ruminal microbial fermentation characteristics alter in response to the nutritional shift of the animal under heat-stress conditions. We evaluated the changes of the ruminal bacterial community composition in cows under heat-stress conditions by applying an RNA-based method (sequence-specific small-subunit rRNA cleavage method), which was optimized for the comprehensive description of predominant bacterial groups inhabiting the rumen. The same four Holstein cows were subjected to two separate experiments with the different age and relative humidity (RH) (Experiment 1, nine months, 80% RH; Experiment 2, 15 months, 60% RH). In each experiment, the cows were kept under three temperatures (20°C, 28°C, 33°C) in a climatic chamber for two weeks each. The cattle were offered a mixed ration (45% Italian ryegrass hay silage, 5% alfalfa hay cube, and 50% concentrate) twice a day. Rumen fluid samples were used for total RNA extraction. For quantitative detection, we applied a set of 15 oligonucleotide probes including those which targeted clusters comprised of uncultured rumen bacteria (URB) belonging to the low-GC Gram-positive bacteria phylum. The total amount of 16S rRNAs of those targeted groups accounted for 93% max of the total bacterial 16S rRNAs. The *E. rectale - C. coccoides* group and the genus *Streptococcus* increased, and the genus *Fibrobacter* decreased in response to increasing temperature. In addition, the population of one defined URB cluster was higher at 33°C compared to 20°C, whereas one of the other URB clusters decreased with the temperature rise. These results indicate that exposure to a hot temperature can affect the composition of the ruminal microbial community and that uncultured rumen bacteria play a critical role in ruminal fermentation which can respond to temperature change.

Key Words: Rumen Microbial Community, Heat-Stress, 16S rRNA

T311 Application of carbohydrase inhibitors to moderate rumen fermentation: Continuous culture evaluation. S. M. Speight*[1], D. L. Harmon[1], and J. M. Tricarico[2], [1]*University of Kentucky*, *Lexington*, [2]*Alltech Biotechnology*, *Nicholasville, KY*.

While carbohydrase inhibitors have been widely investigated for regulating human carbohydrate assimilation, their application to animal nutrition has been ignored. Two continuous culture experiments were conducted to determine how microbial-derived α-amylase and α-glucosidase inhibitors affect rumen fermentation. rumen fluid from two mature holstein steers (1045 ± 8.0 kg bw) fed a 50% concentrate, 50% forage diet was strained, mixed, and loaded into 1-l single-flow continuous culture fermenters. McDougall's buffer was continuously infused via a peristaltic pump (60 mL/h). Treatments in Exp. 1 consisted of: no additive, 88 mg and 166 mg acarbose/d. Treatments in Exp. 2 consisted of: no additive, 4 mg, 8 mg, and 12 mg trestatin/d. Treatments were added to a purified diet (90% corn starch, 10% casein salt) that was fed to each vessel twice daily. Each experiment consisted of a 3-d adaptation period followed by a 3-d sampling period. Ammonia, VFA, and pH were measured twice daily. Effluent outflow was collected daily and frozen for subsequent lab analyses. Acarbose and trestatin linearly increased ($P \leq 0.02$) pH and ammonia concentrations. Lactate decreased linearly ($P = 0.02$) with acarbose but was unaffected by trestatin. Acarbose did not affect acetate or propionate but did quadratically decrease ($P < 0.05$) butyrate, valerate and tended ($P = 0.09$) to linearly decrease total VFA concentrations. Acarbose quadratically increased ($P = 0.03$) the molar proportions of acetate and tended to decrease ($P = 0.06$) the molar proportions of propionate. Trestatin linearly decreased ($P = 0.03$) valerate concentrations and increased the molar proportion of acetate (linear; $P = 0.02$). Starch disappearance and effluent N decreased linearly ($P \leq 0.05$) with both treatments. Acarbose increased (linear; $P = 0.03$) effluent energy (kcal/d) whereas trestatin decreased effluent energy (linear; $P = 0.05$). Carbohydrase inhibitors can modify fermentation in a dose dependent manner. They may offer the potential to either moderate the rate of fermentation and/or shift digestion to the small intestine.

Key Words: Carbohydrase Inhibitors, Rumen Fermentation Modulators, Continuous Culture

T312 Efficacy of *Prevotella bryantii* 25A and a mixture of *Enterococcus faecium* and *Saccharomyces cerevisiae* to control sub-clinical acidosis in dairy cows. J. Chiquette*[1], M. J. Allison[2], and M. A. Rasmussen[3], [1]*Dairy and Swine Research and Development Centre*, *Lennoxville, Quebec, Canada*, [2]*Iowa State University*, *Ames*, [3]*SarTec Corporation*, *Anoka, MN*.

The objectives of this study were 1) to evaluate *Prevotella bryantii* strain 25A (P) and a mixture of *Enterococcus faecium* and *Saccharomyces cerevisiae* (ES) as probiotics to sustain higher ruminal pH; 2) to study their effect on animal feed intake, milk production and composition, in dairy cows submitted to a sub-acute rumen acidosis (SARA) challenge. Six ruminally-fistulated Holstein dairy cows in mid-lactation were equally distributed between the following treatments, in a replicated 3 × 3 Latin square design: 1) Control (C), animals were fed a total mixed ration (TMR); 2) TMR + 2g/head/day of ES (5×10^9 CFU); 3) TMR + 25 ml/head/day of P (2×10^{11} cells/dose). The Latin square consisted of 3 weeks (wks) of adaptation, 4 days during which a specific feeding procedure was used to induce SARA and 10 resting days during which the animals were back to the control TMR with no probiotic supplementation. Rumen pH was recorded every 10 min over a

24h-period during each of the three wks of adaptation and during the wk of resting and continuously during the 4 days of SARA. All pH parameters averaged over treatments were different when comparing adaptation wks and challenge wks ($P < 0.001$). ES tended ($P < 0.10$) to increase median pH values obtained during 24h periods (5.6 vs 5.4, for ES and control, respectively). Maximum pH recorded during 24-h periods tended ($P < 0.06$) to be higher when animals received ES than when they were controls (6.6 vs 6.3). Percentage of time during which rumen pH was below the threshold of 5.2 and 5.6 was numerically less with ES than with C (22 vs 35% of time below 5.2 and 46 vs 62% of time below 5.6, with ES and C, respectively). There was no effect of probiotics on dry matter intake. Milk production and composition were not affected by treatments. Treatment P increased ($P < 0.05$) ammonia concentration compared to C during the first day of challenge. Results from this study indicate that ES tended to sustain higher ruminal conditions when animals were induced with SARA, further research is needed to confirm its efficacy in the prevention of SARA.

Key Words: Sub-Acute Ruminal Acidosis, Probiotics, Dairy Cows

T313 Differential effects of supplying reductant as hydrogen, formate or a combination of these on the methane-inhibiting activity of select nitrocompounds in vitro. N. A. Kruegar*, R. C. Anderson, T. R. Callaway, T. S. Edrington, R. B. Harvey, and D. J. Nisbet, *USDA/ARS, Food & Feed Safety Research Unit*, *College Station, TX*.

Short chain nitrocompounds markedly inhibit ruminal methane (CH_4) production, a digestive inefficiency resulting in losses of up to 12% of gross energy intake, but little is known regarding their mechanism of activity. Here, we report the effects of supplying reductant as H_2, formate or both (60 µmol/ml ruminal fluid each) on H_2 and CH_4 accumulation during 24 h incubation (39ºC) of ruminal fluid with or without 12 mM 2-nitro-1-propanol, 3-nitro-1-propionic acid, nitroethanol or nitroethane in vitro (n=3). Reductants were supplied as sodium formate or H_2:CO_2 (80:20); cultures without added H_2 were incubated with 100% CO_2. Analysis of variance revealed main effects (P<0.0001) of nitrocompound, reductant and their interaction on both H_2 and CH_4 accumulation. When reductant was supplied as formate, all nitrocompounds reduced (P<0.05) CH_4 production >99% from that produced by controls incubated with formate alone (13.55±0.9 µmol/ml). Accumulation of H_2 did not differ between any of the incubations containing reductant as added formate alone and averaged 1.07±0.6 µmol/ml. This suggests that the nitrocompounds markedly inhibited methanogenic oxidation of formate and likely inhibited its catabolism to H_2 by other bacteria as well. Conversely, nitro-supplementation decreased (P<0.05) CH_4 production 58 to 97% from that of controls containing no added nitrocompound (11.62±0.9 and 8.43±1.3 µmol/ml, respectively) when reductant was supplied as H_2 or H_2 plus added formate. In this case, however, nitro-supplementation increased (P<0.05) H_2 accumulations >77 to 98% higher than that in non-nitrocompound containing controls (1.66±1.6 and 0.23±0.1 µmol/ml, respectively). These results show that nitro-supplementation more effectively reduced CH_4 production in non-adapted ruminal populations when reductant was supplied as formate rather than H_2 and in both cases inhibited the ability of methanogens to oxidize these reductants.

Key Words: Methane, Nitrocompound, Rumen

T314 Effect of level of dietary malic acid supplementation on rumen methanogenesis and fermentation in beef cattle. P. Foley, J. Callan, D. Kenny*, T. Boland, and F. O'Mara, *University College Dublin*, *Dublin, Ireland*.

The objective of this study was to determine the effect of level of dietary malic acid (MA) on rumen methanogenesis and fermentation in beef cattle. Two Latin square designed experiments took place. In experiment 1 (Exp1) 6 heifers were assigned to one of 3 levels (0%, 3.75%, and 7.5% DMI) of MA inclusion over 3 periods. In experiment 2 (Exp2) 4 fistulated steers were assigned to 1 of 4 levels of MA (0%, 2.5%, 5.0% and 7.5% DMI) over 4 periods, diets consisted of 40:60 Forage:Concentrate ratio with grass silage as the forage. Experimental periods consisted of 28 d, incorporating a 13 d acclimatization period, followed by a 5 d period for Exp1 during which methane (CH4) output was measured using the SF6 tracer gas technique and digestibility was measured by use of the chromic oxide tracer technique dosing twice daily before each feed with 1g Cr2O3, followed by a 10 d rest period. Faeces sub samples were collected from d 16 to 18, dried and analysed for chromium. In Exp2 rumen fluid (RF) was collected from the reticulum area, on d 16 to 18, immediately prior to feeding then 2, 4, 6 & 8 hours post feeding. pH was immediately determined and samples taken for protozoa count, VFA and NH3 analysis. DMI was recorded daily for both experiments. The dietary inclusion of MA led to a linear reduction ($P < 0.05$) in DMI and in total daily CH4 emissions. The highest level of MA led to a 9% reduction ($P < 0.05$) in CH4 emissions per kg DMI when compared to the control diet. There was no effect on ruminal concentrations of VFA with the exception of a tendency towards an decrease in acetate and butyrate with increasing dietary MA. There was a tendency towards lower NH3 with decreasing dietary MA (P=0.05). Ruminal pH was lower ($P < 0.05$) on 5 and 7.5% MA compared with either 0 or 2.5%. However there was no difference between any other treatment comparisons in pH ($P > 0.05$). Protozoal numbers were higher ($P < 0.05$) on 0% MA compared with either 5 or 7.5% MA. Results suggest scope for MA to reduce CH4 emissions however advantages may be negated by depressed DMI.

T315 Usefulness of infrared imaging as a predictor of heat loss and methane production in dairy cows. Y. R. Montanholi*, N. E. Odongo, K. C. Swanson, F. S. Schenkel, B. W. McBride, and S. P. Miller, *University of Guelph*, *Guelph, Ontario, Canada*.

Infrared images (IRI) have proved useful for the assessment of certain phenomena such as the detection of inflammatory illnesses and prediction of meat quality. Conversely, it is less clear if IRI could be used to predict feed efficiency or to assess dietary effects. Herein, relationships among IRI, heat loss (HE) and methane production (CH) were investigated. Four lactating Holstein dairy cows (live weight: 609 + 60.0 kg; milk yield: 27 + 5.1 kg/d; days in milk: 92.5 + 2.6) housed in a tie-stall facility were fed a total mixed ration (TMR) with a forage:concentrate of 60:40 and NE_L of 1.55 Mcal/kg. Cows were allocated to 1 of 2 treatments: TMR plus a control placebo premix (CO) or TMR plus monensin premix (24 mg/kg DM) (MO) offered for ad libitum intake. Each pair of cows (one from each treatment) was monitored 1 day/month (from 09:00 a.m. to 3:30 p.m.) for 6 months. On the sampling days, IRI from the left and right flank (LFK and RFK) and from the rear area (RAR) of the cows were taken every 20 minutes. As well, CH and oxygen consumption were simultaneously monitored around the timing of each set of IRI using an indirect calorimetry unit with two ventilated head-hoods. The oxygen consumption was later

used to calculate heat loss (HE). Heat loss was correlated with LFK and RFK temperatures (r = 0.25 and 0.16; P<0.01) but not with RAR temperature (r = 0.09; P<0.10) across treatments. Within treatment the correlation between HE and CH was higher in the CO vs. MO (r = 0.50 vs. 0.17; P<0.01). HE and CH were more closely associated with RFK and LFK temperatures in CO than in MO-treated cows (HE: r = 0.43 and 0.30 vs. 0.13 and 0.12; CH: r = 0.45 and 0.42 vs. 0.29 and 0.28; P<0.01). Correlations among IRI and HE and CH observed within days and treatments were not uniform. Infrared images may be useful in the assessment of heat losses, methane production and dietary treatment effects but further investigations are warranted.

Key Words: Feed Efficiency, Greenhouse Gas Emissions, Monensin

T316 Profiling energy substrate metabolism in isolated rumen epithelial and duodenal mucosal cells from beef cattle. S. W. El-Kadi*[1], R. L. Baldwin[2], K. R. McLeod[3], N. E. Sunny[1], S. L. Owens[1], and B. J. Bequette[1], [1]*University of Maryland*, *College Park*, [2]*USDA-ARS*, *Beltsville, MD*, [3]*University of Kentucky*, *Lexington*.

The aim of this study was to determine the relative contribution of substrates to Krebs cycle metabolism by rumen epithelial (REC) and duodenal mucosal (DMC) cells. Another aim was to determine the influence of diet type on the selection and metabolism of substrates. Two groups of Angus bulls (n = 6/group) were fed either a 75% Orchardgrass silage (HF) or a 75% concentrate mix (HC) diet for 4 w prior to slaughter. Isolated REC and DMC were incubated in media containing all amino acids, and [U-^{13}C] labeled forms of either glucose, glutamate (GLU), glutamine (GLN), leucine (LEU) or valine (VAL) at four levels. There was a diet × tissue effect on glucose metabolism ($P < 0.001$). For REC, glucose contributed 12% of lactate synthesis in cattle fed the HF diet, compared to 25% in cattle fed the HC diet. Although 25% of lactate synthesis by DMC derived from glucose, diet had no effect and no glucose carbon contributed to Krebs metabolism. There was a diet × tissue effect ($P < 0.01$) on LEU metabolism. LEU contributed 45% to ketoisocaproate synthesis in REC from cattle fed the HC diet but only 35% in REC from the HF group and 35% in DMC from the HC and HF groups. VAL contribution to ketoisovalerate synthesis was greater ($P < 0.001$) in REC (58%) compared to DMC (40%), irrespective of diet ($P = 0.13$). For both LEU and VAL, there was no contribution to Krebs metabolism. There was a diet × tissue × level effect on GLU metabolism ($P < 0.01$); its metabolism to α-ketoglutarate was greater in REC from the HC compared to the HF group, whereas GLU metabolism to α-ketoglutarate was lower for DMC from the HC compared to the HF group. The contribution of GLU to α-ketoglutarate flux ranged from 3% to 63% whereas that of GLN did not exceed 3%. The results indicate that glucose is partially metabolized by isolated REC and DMC, but only to lactate. And, although GLU is a significant contributor to REC and DMC Krebs cycle flux, there is limited catabolism of GLN by these isolated cells for entry into the Krebs cycle.

Key Words: Gastrointestinal, Amino Acids, Glucose

T317 Rumen wall morphology and the change in bovine rumen absorptive capacity induced by varying digesta volume and pH. L. Q. Melo, F. Lopes, M. N. Pereira*, M. C. Guerreiro, S. F. Costa, and J. C. Resende Júnior, *Universidade Federal de Lavras*.

Effects of digesta volume and pH on VFA absorption, and its correlation with rumen wall morphology, were evaluated. Nine fistulated cows formed three conditions. C1 had Holsteins, yielding 25.9 kg/d, and fed on a high grain TMR. C2 had Holstein-Zebu crossbreds, yielding 12.3 kg/d, and fed on corn silage, tropical pasture and concentrate. C3 had non-lactating, grazing Jerseys. The aim was to obtain disparity in rumen morphology. Within each condition, a sequence of three treatments was applied in 3x3 Latin Squares, with seven-day periods: High Volume, High pH (HVHP); Low Volume, High pH (LVHP); and Low Volume, Low pH (LVLP). High Volume was obtained by putting back the whole evacuated rumen digesta (59.5 kg), and Low Volume by returning only 25 kg. Low pH was obtained with a 50% H_2SO_4 solution, capable of decreasing rumen pH to 5 (170 ml, on average). Rumen wall was biopsied on day 1 of period 1. Morphometrics involved four macroscopic and four microscopic variables. Rumen VFA absorption was estimated by the Valerate-CrEDTA technique. Digesta with markers was returned after closing the reticulum-omasum orifice with a sponge. The exponential decay rate in rumen valerate to Cr ratio (k Val/Cr) was estimated with digesta samples obtained every 20-minute for 4 hours. There was strong rumen morphology variability among the groups of cows. Well fed Holsteins had increased rumen wall absorptive surface area and basal cells mitotic index, and decreased thickness of the epithelium and of the keratin layer. Mean rumen pH throughout the four hour sampling period were: 6.78 for HVHP, 7.08 for LVHP and 5.90 for LVLP (P<0.01). The k Val/Cr values for treatments HVHP, LVHP and LVLP were, respectively (%h^{-1}): -19.6, -23.9 and -35.0 (SEM=2.01; P=0.21 for contrast HVHP *vs.* LVHP and <0.01 for contrast LVHP *vs.* LVLP). Rumen valerate clearance by absorption was faster in low pH, while decreasing digesta volume did not elicit such a response. The correlation between the absorptive surface area per cm^2 of rumen wall, and the mean of the three k Val/Cr values of each cow, was -0.90 (P<0.01).

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Key Words: Rumen Epithelium, Volatile Fatty Acids, Dairy Cows

T318 Morphophysiologic evaluation of absorption and metabolism of volatile fatty acids by bovine forestomach. J. L. P. Daniel and J. C. Resende Júnior*, *Universidade Federal de Lavras*, *Lavras, MG, Brazil.*

The absorptive surface of the reticulum-rumen (7.7m^2) is higher than that of the omasum (2.1m^2), however, the absorption potential of each compartment is not known. The purpose of this study was to compare, *in vitro*, the VFA absorption and metabolism capacity of the rumen and omasum. After the slaughter, fragments of the rumen wall and omasum laminae were taken from eight adult cross-bread bovines. The fragments were dissected and an isolated fragment of the mucosa was fit in a tissue diffusion chamber. 25mM of valeric acid and 1mM of Cr-EDTA was added to the ruminal fluid and placed on the mucosal side (pH=6.8) and Krebs-Ringer bicarbonate buffer on the serosal side (pH=7.4). The fractional absorption rates were measured by the exponential decay rate of the VFA:Cr. The percentage of metabolized acid was determined by the difference between VFA concentration on mucosal and serosal sides. The absorption surface of the rumen fragment (57.6cm^2) was higher (P<0.001) than that of the omasum (2.5cm^2), because of the ruminal papillae. The fractional absorption rate was higher (P<0.001) in the omasum (9.1%.h^{-1}.cm^{-2}) than in the rumen (0.4%.h^{-1}.cm^{-2}). When the total area was considered the

absorption potential of the omasum was higher (P<0.001) than the rumen. The percentage of metabolized acetate (10.9%) was lower than propionate (31.1%) which was lower than butyrate (39.8%) and valerate (42.6%). When the mucosae areas were considered, there was an interaction (P<0.001) between the percentage of metabolized VFA and the forestomach compartments. In the rumen, the percentage of metabolized VFA was similar (0.68%.cm^{-2}), but in the omasum, the valerate (15.5%.cm^{-2}) was more metabolized than butyrate (14.6%.cm^{-2}) which was higher than propionate (11.58%.cm^{-2}) and acetate (4.33%.cm^{-2}). The estimated metabolism considering the total area was higher (P<0.001) in the omasum than in the rumen. The VFA absorption potential of the omasum is higher than that of the rumen and this could explain, at least partially, the higher VFA metabolization rate found in the omasum wall.

Key Words: Rumen, Omasum

T319 Evaluation of procedures for isolation of ruminant enterocytes. P. R. Regmi*, W. T. Dixon, and M. Oba, *University of Alberta*, *Edmonton, AB, Canada*.

The objective of this study was to evaluate the procedures for isolation of ruminant duodenal mucosal cells (DMC) to be used for *in vitro* studies. Duodenal segments were obtained from a local abattoir immediately after slaughter. The DMC were isolated using three different procedures previously used for sheep (procedure A), pig (procedure B) and cow (procedure C). In the procedure A, the mucosal scrapings collected from the duodenal segment were incubated at 37°C for 20 minutes in a solution containing collagenase, dispase, and $CaCl_2$. In the procedure B, the duodenal segment was filled with Krebs Henseleit buffer containing EDTA without enzymes, and incubated at 37°C for 50 minutes. In the procedure C, the duodenal segment filled with Krebs-Ringer HEPES buffer (KRB-HEPES) containing bovine serum albumin (BSA) was incubated at 37°C for 15 minutes and after discarding the buffer, it was again filled with KRB-HEPES containing hyaluronidase and BSA for 2 minutes to isolate the DMC. The total viable cells per isolation from 50 cm long duodenal segment were significantly higher ($P < 0.05$) for the procedure C ($1.85 \times 10^9 \pm 0.04 \times 10^9$) compared to the procedures A ($1.66 \times 10^9 \pm 0.04 \times 10^9$) and B ($1.58 \times 10^9 \pm 0.07 \times 10^9$). The cell viability immediately after isolation were significantly lower ($P < 0.05$) for the procedure B (78.7 ± 1.8%) compared to the procedures A (85.5 ± 0.8%) and C (88.5 ± 1.7%) and the cell viability after 6 hours was 84.0 ± 0.7, 75.0 ± 1.7 and 86.0 ± 1.7%, respectively for procedures A, B and C. These observations indicate that all the procedures can isolate sufficient viable ruminant DMC for *in vitro* studies, however the number of viable DMC 6 hours after isolation was highest for the procedure using KRB-HEPES containing hyaluronidase.

Key Words: Ruminants, Duodenal Mucosal Cells, Cell isolation

T320 Ruminal, but not abomasal, infusion of starch differentially increases expression of concentrative nucleoside transporter (CNT) mRNA by small intestinal (SI) epithelia of forage-fed beef steers. S. F. Liao*, M. J. Alman, E. S. Vanzant, E. D. Miles, D. L. Harmon, K. R. McLeod, J. A. Boling, and J. C. Matthews, *University of Kentucky*, *Lexington, KY, USA*.

This experiment was conducted to determine if expression of SI concentrative nucleoside transport proteins (**CNT1, 2, 3**) are responsive to luminal supply of rumen-derived bacteria (hence, nucleic acid substrate), energy, or both. Eighteen ruminally and abomasally catheterized Angus steers (BW˜250 kg) were assigned (n=6) to either water (control) or ruminal or abomasal corn starch (α-amylase hydrolysate, at 20% of ME intake) infusion treatments and fed an alfalfa-cube diet at 1.5× NE_m requirement. After a 14 to 17-d infusion period, steers were killed and duodenal (**D**), jejunal (**J**), and ileal (**I**) epithelia were harvested for total RNA extraction. Real-time PCR analyses were conducted to quantify the relative RNA (CNT:18S) expression of CNT1, CNT2, and CNT3 mRNA. Within control steers (n=6), 1.2- and 2.5-fold more (P<0.02) CNT1 was expressed by J than by D or I, respectively. For both CNT2 and CNT3, more (P<0.01) mRNA was expressed by D (9.8- and 1.9-fold) and J (11.4- and 3.1-fold) than by I, respectively. Within a tissue site, the expression of CNT1 or CNT2 mRNA was not affected by infusion treatments, but CNT3 mRNA expression by D (0.65- and 0.69-fold) and I (2.3- and 1.1-fold) of the ruminally starch-infused steers was greater (P<0.04) than by the water- or abomasally starch-infused steers, respectively. These results indicate that these known CNT mRNA are expressed throughout SI epithelia and that CNT3 mRNA expression by D and I epithelia likely is upregulated in the presence of increased nucleoside supply, but not of increased luminal energy (starch) supply.

Key Words: Bovine, Regulated gene expression, SLC28

T321 Effect of hybrid (high starch content vs. high NDF digestibility) and maturity of corn silage on dairy cow performance. R.L.G. Zom*[1], H.A. van Schooten[1], and H. van Laar[2], [1]*ASG Wageningen University & Research Centre*, *Lelystad, Netherlands*, [2]*Nutreco Ruminant Research Centre*, *Boxmeer, Netherlands*.

A 2×2 factorial designed experiment was conducted to evaluate the effects of hybrid (S: high starch content vs. F: high NDF digestibility) and maturity (30 vs. 36% DM) of corn silage on *in situ* degradation and dairy cow performance. Seventy-two HF cows were assigned to four silage treatments and individually fed. Mixtures containing one of the corn silages, haylage and soy bean meal (70:18:12 DM basis) were offered *ad libitum*. Additionally, each cow received 7 kg/d of concentrate. Intake, milk yield and milk composition were analyzed for wk 1 until wk 15 of lactation. The treatment period was from wk 5 to wk 15 of lactation. Pre-treatment data (wk 1 to 4) were used as covariates. In addition, fresh silage samples were ruminally incubated to determine the rate and extent of starch and NDF degradation. Maturity increased starch content and proportion of rumen by-pass starch. Proportion of rumen by-pass starch in hybrid S was 33% and 54% for 30 and 36% DM, respectively, and in hybrid F 23% and 33%. NDF content was higher for hybrid F than for S. All silages had similar NDF degradation characteristics. Despite corn hybrids were from different selection traits, within maturity, starch content was similar. Maturity decreased NDF intake (8.5 vs. 8.2 kg/d; p<0.05) and increased starch intake (4.4 vs. 5.0 kg/d; p<0.001). Maturity had no effect on yields of milk and milk components. Hybrid S increased the intakes of NEL (158 vs. 164 MJ/d; p<0.05), starch (4.6 vs. 4.9 kg/d; p<0.05) and DM (23.1 vs. 23.9 kg/d; p<0.1). Hybrid S improved the yields of milk (39.6 vs. 37.9 kg/d; p<0.05), protein (1.28 vs. 1.21 kg/d; p<0.01) and lactose (1.86 vs. 1.78 kg/d; p<0.01) compared to hybrid F. Observed differences may be associated with a more efficient energy utilization due to a shift in starch digestion from the rumen

to the intestine for hybrid S as indicated by the higher proportion of by-pass starch.

Key Words: Corn Silage, Starch, NDF

T322 Effects of a bacterial inoculant on fermentation, nutritive quality and degradability of corn, soybean and combined corn-soybean silages. L. O. Abdelhadi*[1] and J. M. Tricarico[2], [1]*Est. El Encuentro, Research & Extension in Ruminant Nutrition*, *Cnel. Brandsen, Argentina*, [2]*Alltech Inc.*, *Nicholasville, KY.*

A randomized complete block design with a 2x3 factorial treatment arrangement was used to evaluate the effects of a bacterial inoculant (Sil-All®, Alltech Inc., Nicholasville, KY) on fermentation, nutrient composition and OM degradability (**OMD**) of ensiled corn (DK682RR, Dekalb, Colon, Argentina), soybean (DM4800, Don Mario, Chacabuco, Argentina) and the corn-soybean combination (56% corn and 44% soybean, DM basis). Inoculation (0 or 5 g/ton fresh matter) and ensiled crop (corn, soybean or combination) were the factors examined. All crops were fine chopped (9 mm) and ensiled in polyethylene bags (70m long x 2.75m diameter) using a forage inlay machine. Bacterial inoculation was randomly assigned to each crop or crop combination within a bag and applied directly with the chop harvester applicator. Composite samples (9 sub-samples) were collected for each treatment combination in each block before and after ensiling for 60 d. Samples were analyzed for DM, OM, CP, NDF, WSC, starch, EE and OMD after incubation with ruminal fluid for 3, 6, 12, 24, 48 and 72h. True protein, pH and NH_3-N were also determined on silage samples. Digestible DM yield (tons/ha) before ensiling was similar for corn (13.7) and the combination (12.3) and lower ($P<.05$) for soybean (5.7). As expected, nutrient composition for the crop combination was intermediate between corn and soybean both before and after ensiling. No interactions (inoculation x crop) for nutrient composition, fermentation or OMD were detected. Silage pH was lower ($P<.05$) for corn (3.90), intermediate for the combination (4.17) and greater for soybean (4.84). Inoculation increased ($P<.05$) true protein (60.5 vs. 54.4 %CP) and WSC (8.47 vs. 6.08 %DM) concentrations and the total amount of digestible OM (66.7 vs. 61.2 %OM) across all silages without changing the rate of OMD. We conclude that ensiling corn and soybean in combination provides a single feedstuff with intermediate nutrient composition without negatively affecting yield or total nutrient supply to the ruminant. In addition, bacterial inoculation improved silage nutritive quality across all crops.

Key Words: Corn Silage, Soybean Silage, Inoculant

T323 Effects of a bacterial inoculant on fermentation, nutritive quality and degradability of combined corn-soybean silages in different geographical regions across Argentina. L. O. Abdelhadi*[1] and J. M. Tricarico[2], [1]*Est. El Encuentro, Research and Extension in Ruminant Nutrition*, *Cnel. Brandsen, Argentina*, [2]*Alltech Inc.*, *Nicholasville, KY.*

A randomized complete block design with a 2x5 factorial treatment arrangement was used to evaluate the effects of a bacterial inoculant (Sil-All®, Alltech Inc., Nicholasville, KY) on fermentation, nutrient composition and OM degradability (**OMD**) of corn (DK684RR2, Dekalb, Colon, Argentina) and soybeans (Groups 5.5 grain varieties) ensiled in combination. Bacterial inoculation (0 or 7.5 g/ton fresh material) and geographical-climatological location (Castelli, Jesús María, Pehuajó, Río Cuarto, Tucumán) were the two factors examined. The corn-soybean combination was harvested at each location when corn was at half milk line of grain maturity and soybean was at R6 stage of growth (full seed). Crops were chopped together at harvest (30±1.5% soybean inclusion on a DM basis in all silages) and ensiled in polyethylene bags (70 m long x 2.75 m diameter) using a forage inlay machine. Bacterial inoculation was randomly assigned within each block and applied directly with the chop harvester applicator. Composite samples (9 sub-samples) were collected for each treatment in each block before and after ensiling for 60 d. Samples were analyzed for DM, OM, CP, NDF, WSC, starch, true protein and OMD after incubation with ruminal fluid for 3, 6, 12, 24, 48 and 72h, and pH was also determined on silage samples. As expected, geographical location had a dramatic influence on digestible DM yield, nutrient composition and OMD of the combined crop before ensiling. No interactions (location x inoculation) were detected for fermentation, nutrient composition or OMD. Inoculation had no effects on pH, DM, OM, NDF, or ADF concentrations, but increased ($P<.05$) CP (9.8 vs. 9.1 %DM), true protein (49.7 vs. 47 %CP) and starch (17.2 vs. 15.1 %DM) concentrations and the total amount of digestible OM (71.4 vs. 66.7 %OM) across all locations without changing the rate of OM digestion. We conclude that bacterial inoculation improved silage nutritive quality and OM digestibility of the corn-soybean combination across all geographical locations.

Key Words: Corn Silage, Soybean Silage, Inoculant

T324 Effects of a bacterial inoculant on fermentation, nutritive quality and degradability of different sorghum silage hybrids. L. O. Abdelhadi*[1] and J. M. Tricarico[2], [1]*Est. El Encuentro, Research and Extension in Ruminant Nutrition*, *Cnel. Brandsen, Argentina*, [2]*Alltech Inc.*, *Nicholasville, KY.*

Two studies were conducted on consecutive years (2005 and 2006) to evaluate the effects of a bacterial inoculant (Sil-All®, Alltech Inc., Nicholasville, KY) on silage fermentation, nutrient composition and OM degradability (**OMD**) of different sorghum hybrids. Four hybrids (**ABMR** = sweet brown mid rib sorghum, **FBMR** = forage brown mid rib sorghum, **GRAN** = grain sorghum, **SUDG** = sudangrass sorghum) were ensiled in 2005 and five hybrids (idem 2005 plus **SGRA** = high grain sudangrass sorghum) in 2006. A randomized complete block design with a factorial treatment arrangement was used in each study. Bacterial inoculation (0 or 5 g/ton fresh material) and sorghum hybrid were the two factors examined. Data were analyzed separately for each year. Sorghum was harvested at early dought stage of grain maturity, fine chopped (9 mm) and ensiled in polyethylene bags (70 m long x 2.75 m diameter). Bacterial inoculation was randomly assigned within each block and applied directly with the chop harvester applicator. Composite samples (9 sub-samples) were collected for each inoculation x hybrid combination in each block before and after ensiling for 60 d. Samples were analyzed for DM, OM, CP, NDF, WSC, starch, true protein and OMD after incubation with ruminal fluid for 3, 6, 12, 24, 48 and 72h, pH and NH_3-N were also determined on silage samples. As expected, hybrid had a dramatic influence on nutrient composition and OMD in both studies. Inoculation had no effects on nutrient composition or OMD in 2005. Inoculation increased ($P<.05$) the concentrations of DM, NDF and the rate of OMD in 2006. The hybrid

x inoculation interaction was significant for starch and pH. Inoculation reduced ($P<.05$) starch concentration on high grain hybrids but not on low grain hybrids. Inoculation decreased ($P<.05$) pH in all hybrids except ABMR and SGRA. We conclude that bacterial inoculation effects were inconsistent across studies but improved silage fermentation and the rate of OM digestibility in 2006.

Key Words: Sorghum Silage, Sorghum Hybrids, Inoculant

T325 Effect of alfalfa silage storage structure and roasting corn on production and ruminal metabolism of lactating dairy cows. S. J. Krizsan*[1], G. A. Broderick[2], R. E. Muck[2], C. Promkot[3], S. Colombini[4], and Å. T. Randby[1], [1]*Norwegian University of Life Sciences*, *Ås, Norway*, [2]*US Dairy Forage Research Center*, *Madison, WI*, [3]*Khon Kaen University*, *Khon Kaen, Thailand*, [4]*University of Milano*, *Milano, Italy*.

The objective of this study was to determine if feeding roasted corn as the principal concentrate source would improve production and nutrient utilization when supplemented to lactating cows fed one of 3 different alfalfa silages (AS). Forty-two lactating Holstein cows (6 fitted with ruminal cannulas) averaging 77 DIM and producing 43 kg milk/d pretrial were assigned to 2 cyclic change-over designs. Treatments were AS, ensiled in bag, bunker, or O_2-limiting tower silo supplemented with ground shelled corn (GSC) or roasted GSC (RGSC). Experimental diets contained 40% AS, 15% corn silage and 35% of either GSC or RGSC on DM basis. No significant interactions between AS and corn sources were detected for any production trait. Although chemical composition of the 3 AS was similar, feeding AS from the O_2-limiting tower silo elicited positive production responses ($P<0.01$). Yields of 3.5% FCM and fat were increased 1.7 kg/d and 150 g/d, and milk fat content was increased 0.3%, when cows were fed diets based on AS from the O_2-limiting silo compared with the other 2 AS. The responses in milk fat were paralleled by an average increase in ADF digestibility of 270 g/d for cows fed AS from the O_2-limiting silo. However, ruminal concentrations of lipogenic VFA were unchanged with AS source. Cows fed RGSC consumed 0.6 kg/d more DM and yielded 30 g/d more protein and 50 g/d more lactose than cows fed GSC diets ($P=0.02$). There was no evidence of increased total tract digestibility of OM or starch, or reduced ruminal NH_3 concentration, when feeding RGSC. Free AA increased, and isovalerate decreased in rumen fluid from cows fed RGSC diets ($P<0.01$). However, responses in production with roasted corn were mainly due to increased DMI, which increased the supply of energy and nutrients available for synthesis of milk and milk components.

Key Words: Alfalfa Silage Storage Structure, Milk Production, Roasted Corn

T326 Changes in fermentation end products and the use of real-time quantitative PCR to monitor the dynamics of *Lactobacillus buchneri* in alfalfa silage. R. J. Schmidt*, J. A. Mills, W. Hu, C. M. Klingerman, E. E. McDonell, and L. Kung Jr., *University of Delaware*, *Newark*.

This study was conducted to determine the fermentation profile and the growth of lactic acid bacteria (LAB) and *L. buchneri* in alfalfa silage treated with 1) nothing (C), 2) *Lactobacillus buchneri* 40788 (400,000 cfu/g) (Lallemand Animal Nutrition, Milwaukee, WI) (LB), or 3) *L. buchneri* 40788 (400,000 cfu/g) and *Pediococcus pentosaceus* (100,000 cfu/g) (Lallemand Animal Nutrition) (LBC). Wilted (45% DM), chopped and treated forage was packed and vacuum-sealed in polystyrene bags and ensiled for 2, 5, 45, 90 and 180 d. The experiment was a completely randomized design and data were analyzed using the GLM procedure of the SAS. Lactic acid bacteria (LAB) in forage and silage were quantified on MRS media, and *L. buchneri* was quantified by qPCR using a unique set of oligonucleotide primers. Fresh forage had 5.52 log cfu/ g of LAB and 3.79 log cfu/g of *L. buchneri*. After 2 d of ensiling, numbers of LAB increased to more than 8 log cfu/g for all treatments. In contrast, the numbers of *L. buchneri* in C remained below 4 log cfu/g but was about 7 log cfu/g in LB and LBC. As ensiling progressed, numbers of *L. buchneri* in C remained lower than 6 log cfu/g but approached 9 log cfu/g in LB and LBC ($P < 0.05$). The pH was lowest ($P < 0.05$) in LBC when compared to C and LB after 2 and 5 d of ensiling but pH was lowest ($P < 0.05$) for C compared to LB and LBC thereafter. Treatments LB and LBC had more acetic acid than C at 45 d of ensiling ($P < 0.05$), which coincided with detectable amounts of 1,2 propanediol. From day 5 onward, LB and LBC had less residual water soluble carbohydrates but more NH_3-N than C ($P < 0.05$). Although naturally occurring amounts of *L. buchneri* can be detected in alfalfa, this population is unable to dominate silage fermentation. Inoculation with *P. pentosaceus* provided a faster rate of fermentation in the early stages of ensiling and did not impair the later effects of *L. buchneri* on the silage fermentation.

Key Words: Alfalfa Silage, *L. buchneri*, Real-Time qPCR

T327 Effect of feeding corn silage based diets deficient in either predicted ruminal nitrogen or metabolizable protein on nitrogen utilization and efficiency. E. B. Recktenwald*, D. A. Ross, and M. E. Van Amburgh, *Cornell University*, *Ithaca, NY*.

The objective of this experiment was to evaluate nitrogen (N) utilization in high producing lactating dairy cattle under conditions of a predicted (1) negative rumen N balance (Diet T), (2) negative metabolizable protein (MP) balance (Diet N), or (3) positive rumen N and MP balances (Diet P). Eighty-eight multiparous lactating Holstein cows (83 ± 20 DIM), were blocked by milk yield and parity and assigned to three diets differing in N content. The diets were formulated with CPM Dairy V3 using library values for all feeds except corn silage. The diets consisted of approximately 50% corn silage, 2% wheat straw and 48% of a diet specific mix. Monensin was included in the diets at 300 mg/cow/d. A transition period of 7 d preceded the treatment period of 100 d. The study was analyzed as a mixed model with repeated measures by week using Proc Mixed (SAS, 2004) and orthogonal contrasts were used to assess differences. Body weight and body condition score did not differ. Dry matter intake and 3.5% FCM were lower for cows fed Diet T however feed efficiency was higher. Plasma urea N values were different among treatments and reflected the amount of N intake. Milk fat depression (MFD) was observed in all cows. To assess the impact of monensin on MFD, 11, 15, and 16 cows from the N, P, and T diets, respectively, were maintained on the diet after the treatment period with no monensin and milk fat percent increased by 30%. Nitrogen efficiency was improved through diet manipulation; however the data suggest greater improvements are possible.

Table 1.

	Diet T	Diet N	Diet P	Contrast P values T vs N	T vs P	N vs P
Diet CP, % DM	14.1	14.0	16.3			
Predicted MP balance, g/d	91	-145	264			
Predicted rumen N balance, g/d	-39	27	29			
DMI, kg/d	24.2	25.5	25.7	0.08	0.03	0.93
Milk, kg/d	43.3	42.6	45.0	0.80	0.23	0.06
3.5% FCM, kg/d	36.4	36.5	39.1	0.99	0.05	0.07
Fat, %	2.54	2.67	2.68	0.45	0.44	1.00
Protein, %	2.90	2.92	2.93	0.93	0.84	0.98
PUN, mg/dL	7.13	8.40	11.31	<0.01	<0.01	<0.01
Milk N:Intake N	0.36	0.33	0.31	<0.01	<0.01	<0.01

Key Words: Nitrogen, Efficiency, Metabolizable Protein

T328 Effects of cutting height and bacterial inoculation on fermentation, nutritive quality and degradability of two corn hybrids. L. O. Abdelhadi*[1] and J. M. Tricarico[2], [1]*Est. El Encuentro, Research & Extension in Ruminant Nutrition, Cnel. Brandsen, Argentina*, [2]*Alltech Inc., Nicholasville, KY.*

A randomized complete block design with a factorial arrangement of treatments was used to evaluate the effects of a bacterial inoculant (Sil-All®, Alltech Inc., Nicholasville, KY) on fermentation, nutrient composition and OM degradability (**OMD**) of two corn hybrids harvested at 20 or 40 cm from the ground. The study included one high grain yield (DK682RR, Dekalb, Colon, Argentina) and one high forage yield (DK790S, Dekalb) hybrid. Hybrids were grown in three 2-hectare plots (block) and harvested at half milk-line stage of grain maturity. Fine chopped (9 mm) corn plant was stored in polyethylene bags (70m long x 2.75m diameter) using a forage inlay machine. Inoculation (0 or 5 g/ton fresh matter) was randomly assigned to each hybrid x cutting height combination within a bag. A composite sample (9 sub-samples) was collected for each treatment combination in each block before and after ensiling for 60 d. All samples were analyzed for DM, OM, CP, NDF, WSC, starch, and OMD after incubation with ruminal fluid for 3, 6, 12, 24, 48 and 72h. True protein, EE, pH and NH_3-N were also determined on silage samples. No interactions were observed before ensiling. Digestible DM (tons/ha) only tended (P<.14) to increase in high grain over high forage yield corn (13.1 vs. 13.0) or 20 over 40 cm cutting height (13.8 vs. 12.3), suggesting the importance of grain concentration on total nutrient supply. High grain yield corn had greater (P<.05) pH, and concentrations of true protein, WSC, and starch but lower NH_3-N and NDF than the high forage yield corn. The rate of OMD was also greater (P<.05) in high grain than in high forage yield corn. Cutting height had no effects on silage fermentation, nutritive value or OMD. Inoculation increased (P<.05) silage CP and true protein concentrations and the total amount of digestible OM in both corn hybrids without changing digestion rate. We conclude that cutting height did not affect silage quality, while bacterial inoculation improved it regardless of hybrid or cutting height. In addition, high grain yield corn provided more nutrients than high forage yield corn after ensiling.

Key Words: Corn Silage, Cutting Height, Inoculant

T329 Continuous culture fermentation of a corn silage-based total mixed ration with additional forage from pasture. R. E. Vibart*, V. Fellner, and S. J. McLeod, *North Carolina State University*, *Raleigh*.

Cultures of mixed ruminal microorganisms were used to examine fermentation profile of diets consisting of either a nutritionally-balanced TMR (**100T**) or one of the following three TMR-pasture combinations: 1) 85% TMR plus 15% pasture (**85T**), 2) 70% TMR plus 30% pasture (**70T**), and 3) 55% TMR plus 45% pasture (**55T**). The pasture portion of the three TMR-restricted diets was annual ryegrass harvested at a height that simulated animal grazing. The forage:concentrate ratio ranged from 40:60 (100T) to 67:33 (55T). Increasing the amount of forage offered to the fermentors altered the molar proportions and daily production of volatile fatty acids (VFA). Total VFA tended (P = 0.08) to be greatest (108.0 mmol/d) for 55T compared to all other treatments (92.5 mmol/d). Reduced (P < 0.05) apparent and true OM degradability was reported for the diets that exhibited the lowest pH values (5.65 and 5.68 for treatments 70T and 100T, respectively). Increasing the amount of forage offered to continuous cultures resulted in increased (P < 0.05) ratios of acetate to propionate and decreased methane production. There was a linear increase (P < 0.05) in the flow of microbial biomass with increasing proportion of forage from pasture. Our data suggest that increased forage from pasture improved ruminal fermentation by supporting greater fermentation and ruminal pH. Despite similar ammonia-N concentrations, increasing the proportion of forage from pasture enhanced nitrogen capture and increased microbial protein flow.

Key Words: Pasture, Total Mixed Ration, Mixed Ruminal Cultures

T330 Partial mixed rations (PMR) as alternative feeding systems for lactating dairy cows in southeastern U.S. R. E. Vibart*, V. Fellner, J. C. Burns, G. B. Huntington, and J. T. Green, *North Carolina State University*, *Raleigh*.

Beginning March 2005, thirty lactating Holstein cows were used in a randomized complete block design to evaluate the partial replacement of a total mixed ration (TMR) by ryegrass pasture on animal responses over an eight week period. Cows averaged 36.6 ± 1.5 kg milk, 125.7 ± 6.7 days in milk, 1.9 ± 0.2 lactations, 607.3 ± 11.9 kg bodyweight, and 2.88 ± 0.06 body condition score at the initiation of the trial. Cows were assigned to an all-TMR diet (**100T**, no access to ryegrass pasture) or one of the following three formulated (actual) PMR: 1) 85% (89%) TMR + 15% (11%) pasture, **85T**; 2) 70% (79%) TMR + 30% (21%) pasture, **70T**; and 3) 55% (65%) TMR + 45% (35%) pasture, **55T**. Cows on pasture grazed as a single group for 7 h/d between the a.m. and p.m. milking. Pasture intakes were measured weekly on one cow selected randomly from each grazing treatment. Pasture dry matter intake was different (P < 0.05) among grazing treatments and averaged 6.9, 4.2, and 2.2 kg/d for 55T, 70T, and 85T, respectively. Fat corrected milk yield was greatest (P < 0.05) for 85T (34.0 kg/d) and lowest for 70T (29.8 kg/d). Milk fat from cows with the greatest pasture intake had greater concentrations of conjugated linoleic acids and decreased concentrations of saturated fatty acids. By week eight, concentrations of plasma nonesterified fatty acids (185.3 vs. 92.5 μeq/L) and plasma urea nitrogen (12.4 vs. 6.7 mg/dl) were greater for 100T compared to the three grazing treatments, respectively, but plasma glucose concentrations did not differ among treatments. Offering pasture did not replace TMR, but lowering TMR intakes lowered total dry matter

intake. Feed efficiencies (kg feed/kg milk) were 0.60, 0.61, 0.56, and 0.68 for treatments 55T, 70T, 85T, and 100T, respectively. Our data shows that cows on a PMR with 11% pasture resulted in the best lactation performance. Although the two treatments offered the greatest amounts of TMR resulted in greater milk yields, all three grazing treatments exhibited enhanced feed efficiencies compared to an all-confinement diet.

Key Words: Total Mixed Ration, Pasture, Lactation Performance

T331 Variability in total mixed ration neutral-detergent fiber analysis among commercial laboratories. A. N. Hristov*[1], S. Zaman[1], M. Vander Pol[1], W. J. Price[1], and D. Mertens[2], [1]*University of Idaho*, *Moscow*, [2]*U.S. Dairy Forage Research Center*, *Madison, WI*.

The objective of this study was to test the variability in amylase-treated NDF (aNDF) of TMR samples among commercial feed analysis laboratories. Two TMR were prepared that varied in the DM proportion of concentrates (corn and barley grains) replacing forage (alfalfa hay and corn silage): 55% (HCD diet) vs. 40% (LCD diet). Replicated TMR and individual feed samples were dried at 65°C to constant weight and ground through a 4-mm screen. Aliquots were sent to 12 commercial and 2 research laboratories for aNDF analysis; all laboratories, except one, re-ground the samples and used amylase and sodium sulfite. The aNDF contents of TMR were estimated based on aNDF content of the individual feeds reported by each laboratory. Results were analyzed statistically using the UNIVARIATE and MIXED procedures of SAS. Method of analysis (crucible vs. filter bag) was used as a classification variable in the statistical analysis. Concentration of aNDF in HCD and LCD by laboratories using the crucible method was 29.2±0.28 and 33.7±0.20%, respectively (n=48). Laboratories using filter bags reported 29.9±0.37 and 33.9±0.39% aNDF, respectively (n=36). Method of analysis had no effect (P = 0.520) on the aNDF values, but variability among laboratories was significant (P = 0.032 and 0.038, HCD and LCD, respectively). The variance estimates for the two methods of aNDF analysis were not statistically significant (P = 0.229 and 0.208, crucibles and filter bags, respectively). There was a significant variability in the analysis of some feeds: barley grain averaged 20.3±1.15% (min=14.0, max=31.0%) and whole cottonseed averaged 45.6±1.51% aNDF (min=35.5, max=56.2%). Estimated aNDF of TMR, based on analysis of individual feeds, were slightly greater than analyzed aNDF values (by 0.32±0.170, P = 0.067 and 0.42±0.135%, P = 0.003 for HCD and LCD, respectively).

Key Words: Neutral-Detergent Fiber, Total Mixed Ration, Analysis

T332 Nutritional quality of sugar cane treated with calcium oxide. A. W. P. Freitas*[1], F. C. Rocha[2], J. L. Fagundes[1], and R. Fonseca[2], [1]*APTA Regional*, *Adamantina, São Paulo, Brazil*, [2]*Unesp - Dracena*, *Dracena, São Paulo, Brazil*.

The aim of this research was to determine the effect of application of different levels of CaO (0.25; 0.5; 1.0; 2.0 and 4.0%) on the nutritional quality of sugar cane. The sugar cane, variety IAC 86-2480, was harvested manually, and chopped in 2 cm lengths with a stationary chopping machine. Each parcel consisted of 50 kg of chopped sugar cane. Individual samples were collected before treatment application (time 0), and after 9 hours. Samples were dried at 70 °C for 48 h in an oven and ground to pass a 1 mm screen. Dry matter content, ash, crude protein, NDF, ADF, water soluble carbohydrate (WSC), lignin and hemicelluloses concentration and in vitro dry matter digestibility (IVDMD) were determined as described by Silva and Queiroz (2002) and pH as described by Bolsen et al. (1992). The results were analyzed by one-way analysis of variance and regression analysis using SAEG 9.1. The forage dry matter decreased linearly ($P<0.01$) with the increase of calcium hydroxide levels, while NDF, Hemicelluloses and DMIVD adjusted to a quadratic ($P<0.01$) model. The data show that application of increasing levels of calcium oxide affects the forage in two steps. First, there was a solubilization of the WSC, resulting in the observed increase in cell wall components concentration. Secondly, the higher levels of the alkali start to affect the cell wall components, which can be observed by the decreasing concentrations of hemicelluloses and NDF. A rather unexpected finding from the experiment was the quadratic behavior of the IVDMD, with a maximum estimated value of 68.5% of IVDMD for the calcium oxide level of 1.75%. This observation can be explained by the degradation of the WSC, with the increasing levels of calcium oxide, which is the most digestible part of the sugar cane. It is concluded that 1.75% is the optimal level of calcium oxide to enhance the nutritional quality of sugar cane for ruminants.

Key Words: Alkali, Hydrolyses, Ruminant

T333 Effects of increasing level of corn distiller's dried grains plus solubles on in situ disappearance in steers offered medium-quality grass hay. J. L. Leupp*, G. P. Lardy, and J. S. Caton, *North Dakota State University*, *Fargo*.

Five ruminally and duodenally cannulated beef steers (446 ± 42 kg of initial BW) were used in a 5 × 5 Latin square to evaluate effects of increasing level of supplemental corn distiller's dried grains with solubles (DDGS; 25.4% CP, 9.8% fat, DM basis) on in situ rate of DM, NDF, and ADF disappearance and CP kinetic parameters of hay and DDGS. Dietary treatments consisted of grass hay (10.2% CP; DM basis) offered ad libitum, free access to water and trace mineral salt block, and one of five levels of DDGS (0, 0.3, 0.6, 0.9, and 1.2% BW DDGS; DM basis). Diets met or exceeded DIP requirements (microbial yield = 10.5%). All supplements were fed at 0600 before hay. Steers were adapted to diets for 14 d followed by a 7-d collection period. Hay DM disappearance responded cubically ($P = 0.02$) with the greatest rate of disappearance at 0.9% DDGS and least at 1.2% DDGS. Hay NDF and ADF disappearance were not affected ($P \geq 0.23$; 3.74 ± 0.45%/h and 3.72 ± 0.46%/h, respectively) by treatment. Hay CP degradation rate increased (linear; $P = 0.0025$) with increasing DDGS while extent of CP degradation decreased quadratically ($P = 0.02$) with the lowest extent at 0.9% DDGS. Hay soluble and slowly degradable CP fractions were similar ($P \geq 0.93$; 25.5 ± 1.7% and 63.0 ± 1.7%, respectively) across treatments. A cubic effect ($P = 0.03$) was noted for DDGS DM disappearance with the greatest disappearance at 0.9% and the least at 0.6% DDGS. No differences ($P \geq 0.45$) among treatments were observed for DDGS NDF or ADF disappearance (3.04 ± 0.71%/h and 3.19 ± 0.94%/h, respectively). Soluble CP degradation fraction decreased (linear; $P = 0.01$) and slowly degradable CP fraction increased (linear; $P = 0.002$) with increasing DDGS. A linear increase ($P < 0.0001$) was observed for CP degradation rate with increasing DDGS. Treatment did not affect ($P = 0.23$) extent of DDGS CP

degradability (99.8% ± 0.2). Using moderate to high levels of DDGS in forage diets resulted in increased degradation rates of CP. Results indicate up to 1.2% BW DDGS can be fed in forage-based diets without adverse effects.

Key Words: Distiller's Dried Grains with Solubles, Medium-Quality Forage, Steers

T334 Evaluation of corn and soybean co-products in beef cattle finishing diets. P. M. Walker*[1], D. Adams[1], and L. A. Forster[2], [1]*Illinois State University*, *Normal*, [2]*Archer Daniels Midland, Co.*, *Decatur, IL*.

Dried distillers grains with solubles (DDGS) and soy hull (SH) supplies have increased due to renewable fuels legislation. This trial evaluated the effects of diets containing 0, 25, or 40% DDGS and 44% SH, and length of time on feed (156, 187, or 263d) on the feedlot performance of 192 Angus crossbred steers (initial wt = 348±1.9 kg). Following an 84d receiving period (P1) in which steers were fed diets containing either shelled corn (SC), SH, or DDGS at 1 or 2% BW, steers were blocked by intake level and assigned within blocks to six dietary treatments (P2) with 4 replicates (24 pens, 6 or 10 steers/pen). Treatments were: 70.5% SC, 13.5% grass hay (GH), 13.5% soybean meal (T1); 59.0% SC, 13.5%GH, 25% DDGS (T2); 40.0% DDGS, 44.0% SH, 13.5%GH (T3); T3 fed for 28d (T4), 56d (T5), or 84d (T6) followed by T2 fed to harvest. Steers were harvested after 156, 187, or 232d on the P2 diets. Data were analyzed using previous dietary treatment (P1) and harvest date as covariates; no interactions were observed between covariates and P2 treatments. Carcass measurements were similar between P2 treatments except for liver abscess scores [T1 higher ($P< 0.05$) than T2-T6]. Length of time on feed increased carcass wt, rib fat, KHP, marbling score and yield grade. Total DMI was similar between T1 and T2 but was higher ($P< 0.05$) for T3-T6. ADG (μ=1.51±0.02kg) and feed efficiency (G:F) (μ=0.12±0.005) were similar between T1 and T2 but lower ($P< 0.05$) for T3-T6 (ADG μ=1.45±0.02kg, G:F μ=0.11±0.005). No significant differences in cost of gain were observed between treatments. Mean carcass measurements were: carcass wt=403±0.8kg, rib fat=20.57±0.01mm, ribeye area=84.3±0.9 sq cm, KHP=2.8±0.1%, marbling score=7.64±0.1 (7=avg choice), yield grade=4.24±0.1, liver score=1.5±0.2 (range=1-5) and dressing percent=62.5±0.2. These data suggest that feeding cattle higher rates of DDGS and SH will result in similar quality and yield grades but will require higher total feed intake with lower ADG than diets containing whole shelled corn or limited to 25% DDGS.

Key Words: DDGS, SH, Finishing Steers

T335 Effects of dietary fat concentration and wet sorghum distiller's grains plus solubles on feedlot performance and carcass characteristics of finishing heifers. J. C. Silva*[1], N. A. Cole[2], M. S. Brown[1], D. L. Mitchell[1], C. H. Ponce[1], and D. R. Smith[1], [1]*West Texas A&M*, *Canyon*, [2]*USDA ARS CPRL*, *Bushland, TX*.

Three hundred ninety-eight crossbred yearling heifers (initial BW = 373.5 kg) were used in two experiments to examine the effect of dietary fat concentration on the feeding value of wet sorghum distiller's grains plus solubles (WSDGS). Treatments included two 92% concentrate diets based on steam-flaked corn (SFC) with 0% or 3% added fat from yellow grease and three diets with 15% WSDGS and either 0, 1.5, or 3% added fat from yellow grease (4 pens/treatment within study). Heifers were fed an average of 106 d before slaughter. Overall DMI was 6.1% greater ($P < 0.01$) for heifers fed WSDGS than for those fed SFC. Among heifers fed WSDGS, DMI was greatest for heifers fed 1.5% fat ($P = 0.04$; quadratic). Overall ADG was 5% greater ($P = 0.04$) for WSDGS compared to SFC. Among WSDGS, ADG tended to be greater for 1.5% fat ($P = 0.12$; quadratic). The ADG:DMI did not differ between SFC with 0 or 3% fat, nor was ADG:DMI altered by replacing a portion of SFC with WSDGS ($P > 0.36$). However, ADG:DMI increased linearly as more fat was added to WSDGS diets ($P = 0.06$). Hot carcass weight was increased an average of 5 kg ($P = 0.05$) when WSDGS replaced a portion of SFC, but carcass weight was greatest for heifers fed WSDGS with 1.5% fat ($P = 0.09$, quadratic). Heifers fed SFC without fat had a larger LM area, lower marbling score, less rib fat, and a lower yield grade ($P < 0.08$) than heifers fed SFC with 3% fat. Heifers fed WSDGS had more rib fat and a higher yield grade ($P < 0.03$) than heifers fed SFC. Inclusion of fat in SFC diets did not alter the distribution of carcass quality grades, but SFC with 3% fat produced fewer ($P = 0.01$) yield grade 1 carcasses than when fat was not fed. Feeding WSDGS did not alter carcass quality grade distribution compared to feeding SFC, but WSDGS produced fewer yield grade 3 carcasses ($P = 0.03$) than SFC. Heifers fed WSDGS had a higher DMI and greater ADG than heifers fed SFC, but gain efficiency did not differ. Adding more than 1.5% fat to diets containing WSDGS tended to reduce growth performance.

Key Words: Fat, Growth Performance, Sorghum Distiller's Grains

T336 Using high-lysine proteins to supplement diets based on dried distillers grains with solubles did not improve lactation performance. E. A. French*, M. He, and L. E. Armentano, *University of Wisconsin*, *Madison*.

The objectives of this study were to compare production responses of lactating dairy cows fed dried distillers grains with solubles (DDGS) combined with other protein sources varying in lysine content. Twenty four lactating Holstein cows (six primiparous and eighteen multiparous) were used in four, replicated 6 × 6 Latin Squares, with 21-d periods. All diets contained 37% corn silage, 18% alfalfa silage, 5% cottonseed and 40% concentrate (DM basis). DDGS at 13% and 18% of diet DM was supplemented with Aminoplus®, a soy-based bypass protein source (13AP and 18AP). DDGS (18% of diet DM) was also supplemented with commodity soybean meal (18SBM), blood meal (18Bl), blood and fish meal (18BlF) and Aminoplus® and blood meal (18APBl). Diets were formulated to have similar NDF and fat concentration. The 18APBl positive control diet was 18.5% CP but the other five diets were isonitrogenous (17.0% to 17.4% CP), No significant differences were found across treatments for DMI (25.3 kg/d), yield of milk (44.5 kg/d), milk protein (1346 g/d), fat (1458 g/d) and lactose (2170 g/d) or milk fat concentration (3.28%). Milk protein percent was higher for the 18APBl diet vs 18AP (3.05% vs. 3.00%; $P<0.05$, one-tailed). This last result implies the cows in this study could respond to added protein, albeit slightly. Therefore, either our hypothesis that diets containing more available lysine would cause increased production responses was incorrect, or the diets did not improve the lysine status of the cows. In either case the quality of the protein in all these 18% DDGS diets appears similar.

Key Words: Dried Distillers Grains with Solubles, Dairy Cows

T337 Effect of feeding dry glycerin to early postpartum Holstein dairy cows on milk production and metabolic profiles. Y.-H. Chung*[1], D. E. Rico[1], A. Martinez[1], K. S. Heyler[1], C. M. Martinez[1], T. W. Cassidy[1], V. Noirot[2], A. Ames[3], and G. A. Varga[1], [1]*Dairy and Animal Science, The Pennsylvania State University*, *University Park*, [2]*Phodé*, *Albi, France*, [3]*NutriLinx, LLC*, *Montpelier, VT*.

Effect of feeding dry glycerin to 39 multiparous Holstein dairy cows (control: n = 19 and glycerin: n = 20; lactation number = 2.2 ± 1.3 SD) on lactational performance and metabolic profiles was investigated. Dry glycerin (minimal 63% of glycerol) was fed at the level of 250 g/cow/d as a topdress to the common lactating TMR from parturition to 21 days postpartum. Individual milk was sampled from 2 consecutive milkings weekly and analyzed for components. Blood was sampled from the coccygeal vein at 4, 7, 14 and 21 days in milk and analyzed for glucose and blood urea nitrogen (BUN). Urine was tested for acetoacetate level weekly using ketostix. Feed intake, milk production and BUN were not affected by glycerin. Percentage of milk protein tended to be lower numerically (P = 0.17) and % of milk fat tended (P = 0.07) to decrease at a faster rate for glycerin supplemented cows than control cows, however yield of milk protein or fat was not different indicating a dilution effect. Cows receiving glycerin tended to have numerically lower urine ketones compared to control cows (6.8 vs. 17.9 mg/dL; P = 0.18). A tendency for treatment by time interaction (P = 0.14) was observed on urine ketones showing that cows receiving glycerin tended to have lower urine ketones on wk 1 and 2 of lactation compared to cows receiving no glycerin. Plasma glucose on wk 2 of lactation corresponded to urine ketones results showing that cows receiving glycerin tended to have higher plasma glucose than cows receiving no glycerin. Results from urine ketones and plasma glucose indicated that at the same level of production, cows receiving glycerin were in a better metabolic status than cows receiving no glycerin. Urine ketones for all cows at any sampling time were below the moderate level (40 mg/dL) for urine ketones during the experimental period.

Key Words: Dry Glycerin, Early Postpartum

T338 Variation over one year of nutrient content of wet brewers grains from a commercial brewery. J. E. Wohlt* and M. L. Westendorf, *Rutgers University*, *New Brunswick, NJ*.

Trailer shipments of wet brewers grains from Anheuser-Busch, Inc., Newark, NJ were sampled daily and composited weekly for 12 months. Both wet and pressed grains were produced at this site. The 48 samples were analyzed at Cumberland Valley Analytical Services, Morgansville, MD. Results for all nutrients are reported as mean (%), SD, and range, respectively. Four of 48 samples contained greater than 40% DM. DM averages of the 48 samples were 34.5%, 4.9 and 27.7 to 51.0 for mean, standard deviation, and range, respectively. Protein fractions were: CP %/DM 33.6, 1.9, and 29.6 to 37.4; soluble protein %/CP 8.3, 1.9, and 4.4 to 12.2; TA-NPN%/CP 9.6 3.7, and 2.9 to 26.6; degradable protein %/CP 28.8, 2.5, and 24.4 to 35.3. The COV for soluble protein and TA-NPN exceeded 20%. Carbohydrate fractions were: starch %/DM 4.3, 1.1, and 2.9 to 7.5; sugar %/DM 4.8, 1.5, and 2.4 to 8.2 with COV exceeding 25%. Fiber fractions were: ADF %/DM 29.9, 1.9, and 18.1 to 25.5; NDF %/DM 48.5, 1.7, and 44.3 to 52.1; lignin %/DM 5.5, 0.3, and 4.9 to 6.2. Fat was: 9.0%, 0.5, and 8.0 to 9.8. Ash was: 7.2%, 2.4, and 3.9 to 9.8 with a COV of 33.0%. Small amounts of macrominerals were present (% of DM): Ca 0.21, 0.02, and 0.17 to 0.26; P 0.55, 0.02, and 0.50 to 0.62; Mg 0.20, 0.02, and 0.16 to 0.24; K 0.09, 0.01, and 0.07 to 0.13; Na 0.010, 0.002, and 0.007 to 0.015. Data illustrate that the nutrient content of wet grains from a single supplier can vary. Simply analyzing or monitoring DM content will not be sufficient when formulating diets.

Key Words: Brewers Grains, Nutrient Content, Variability

T339 The effect of feeding dried distillers grains plus solubles to lactating dairy cows on milk production and excretion of urinary purine derivatives. B. N. Janicek*[1], P. J. Kononoff[1], A. M. Gehman[1], and P. H. Doane[2], [1]*University of Nebraska*, *Lincoln*, [2]*ADM Animal Nutrition Research*, *Decatur, IN*.

The objective of this experiment was to evaluate the effects of feeding dried distillers grains plus solubles (DDGS) on lactational performance of Holstein dairy cows. In addition, we evaluated urinary excretion of purine derivatives (PD) as an indirect estimator of ruminal microbial crude protein production (MCP). Twenty one multiparous and thirteen primiparous mid–to–late lactation cows averaging 178 ± 36 DIM and 651 ± 65 kg BW were randomly assigned to one of two diets in a three period cross–over design. During each of the 21–d periods, cows were offered one of two diets which were chemically similar but differed by the rate of inclusion of DDGS. Dietary treatments were either control (no DDGS) or 30% of diet DM as DDGS. Dried distillers grains plus solubles replaced a portion of dietary forages and concentrates. Diets were formulated to contain similar amounts of CP, NDF, and energy. Dry matter intake was not different (P = 0.19) between treatments (22.8 and 24.0 ± 0.65 kg/d) nor was 3.5% FCM (34.4 and 34.9 ± 1.24 kg/d; P = 0.69). Percentages of milk fat and true protein did not differ between treatments averaging 3.67 ± 0.07% and 2.99 ± 0.03%. The ratio of PD to creatinine was not affected (P = 0.83) by DDGS feeding (2.43 and 2.45 ± 0.07). Similarly, allantoin to creatinine ratios were not different (P = 0.57) between diets (2.23 and 2.28 ± 0.07 respectively). Estimated MCP was not affected (P = 0.80) by DDGS addition (1636 and 1656 ± 58 g/d). In conclusion, purine excretion and estimates of rumen microbial crude protein production were not affected by feeding higher amounts of DDGS. Production results suggest that dairy diets may be formulated to contain DDGS at 30% of the diet DM and maintain acceptable DMI, milk production and milk composition.

Key Words: Dairy Cow, Distillers Grains Plus Solubles, Urinary Purine Derivatives

T340 Effects of Optigen® on fermentation, digestion, and N partitioning in rumen-simulating fermenters fed diets with distillers dried grains. G. A. Harrison*, J. M. Tricarico, M. D. Meyer, and K. A. Dawson, *Alltech Biotechnology*, *Nicholasville, KY*.

The effects of Optigen® (blended, controlled-release urea) on ruminal fermentation, digestion, and N flow in diets with and without distillers dried grains (DDG) were investigated in single-flow rumen-simulating fermenter cultures. Data from 5 experiments (44 cultures) were included in this meta-analysis. Cultures were fed 50% forage diets (corn silage and alfalfa hay), DDG at 0 (DDG0) or 20% (DDG20), and 2 levels of Optigen (0 and 0.55% DM). NPN from Optigen replaced 7.6% of dietary N. Cultures were fed 12.5 g as fed of experimental

diets twice daily for 6 days. Target dilution rate was 0.045 h^{-1}. Samples were collected from cultures prior to morning feeding during the last 3 d of experiments for fermentation analysis. Effluent weights were recorded each day and a composite sample for each fermenter used for DM, OM, and NDF disappearance determination. Nitrogen flow measures were estimated by using purine to N ratios for effluent DM and bacteria. Data were analyzed using the PROC MIXED Model of SAS. Least-square means were compared using Scheffe's test for simultaneous inference. Culture fluid pH, ammonia, and digestion were similar between all-natural protein and Optigen cultures (P>0.10). Cultures receiving Optigen had greater protein degradability (64.0 vs. 67.6, P<0.01) than all-natural protein cultures. Bacterial N yields (0.352 vs. 0.359 g, P>0.10) were not affected by protein source. Cultures fed DDG20 diets had lower ammonia concentrations (5.25 vs. 3.29 mg/dl, P<0.01) and lower true DM digestibility (63.4 vs. 61.1%, P<0.01). DDG20 cultures degraded less protein (68.8 vs. 62.8% of CP, P<0.01) and produced less bacterial N (0.362 vs. 0.349 g/d, P<0.05), but were more efficient (35.1 vs. 36.9 g bacterial N/kg fermentable carbohydrate, P<0.01) than DDG0 cultures. Negative effects of 20% DDG dietary inclusion on N flow in rumen-simulating fermenters were partially negated by addition of Optigen.

Key Words: Non-Protein Nitrogen, Optigen, Distillers Dried Grains

T341 Performance of dairy cows fed glycerol as a primary feed ingredient. S. S. Donkin*[1], M. R. Pallatin[1], P. H. Doane[2], M. J. Cecava[2], H. M. White[1], E. Barnes[1], and S. L. Koser[1], [1]*Purdue University*, *West Lafayette, IN*, [2]*ADM Animal Nutrition Research*, *Decatur, IN*.

Growth of the corn ethanol industry is creating a need for inexpensive feed energy alternatives for lactating dairy cows while concurrent expansion in soydiesel production is expected to promote favorable pricing for glycerol, a primary coproduct material. The objective of this study was to determine the feeding value of glycerol for lactating dairy cattle as a replacement for corn. Sixty lactating Holstein cows, housed in individual tie stalls, were fed a base diet consisting of corn silage, legume forages, corn grain, soyhulls, roasted soybean and protein supplements. After a 2-week acclimation period, cows were fed diets containing 0, 5, 10 or 15% glycerol on a DMB. Glycerol and corn gluten feed in a ratio of 6.25:1 replaced an equivalent amount of corn grain to achieve desired percentages of glycerol in the diet. Cows were milked twice daily and weekly milk samples were analyzed for fat, protein, lactose, total solids, milk urea N, and somatic cells. Body weights and body condition scores were obtained at the beginning and the end of the study. Milk production was 37.0, 36.9, 37.3, 36.4 ± 0.6 kg/d and feed intake was 24.0, 24.5, 24.6, 24.1 ± 0.5 kg/d for 0, 5, 10 and 15% glycerol treatments respectively and did not differ (P > 0.05) except for a modest reduction in feed intake during the first 7 days of the trial for 15% glycerol (treatment x time effect; P < 0.05). Milk composition was not altered in response to glycerol with the exception of decreased (P < 0.05) milk urea nitrogen from 12.5 ± 0.4 mg/dl to an average of 10.6 ± 0.4 mg/dl with glycerol addition. Cows fed 10 and 15% glycerol gained more weight (P < 0.05) than those fed 0 or 5% glycerol; however, body condition scores did not differ among treatments. The data indicate that glycerol is a suitable replacement for corn grain in diets for lactating dairy cattle. Glycerol can be included at rates up to 15% of diet DM without adverse effects on milk production or milk composition.

Key Words: Glycerol, Milk, Biofuels

T342 Evaluation of protein fractionation and ruminal and intestinal digestibility of corn milling co-products. J. M. Kelzer*[1], P. J. Kononoff[1], K. Karges[2], and M. L. Gibson[2], [1]*University of Nebraska*, *Lincoln*, [2]*Dakota Gold Research Association*, *Sioux Falls, SD*.

Inputs for the Cornell-Penn-Miner Dairy model require feed protein to be divided into five fractions: A = non-protein nitrogen; B1 = rapidly degraded true protein; B2 = moderately degraded true protein; B3 = slowly degraded true protein; and C = undegraded true protein. The objectives of this study were to characterize feed protein fractions and evaluate differences in rumen undegradable protein (RUP), RUP digestibility (dRUP), and amino acid concentration in the RUP of seven corn milling co-products. The corn co-products and their respective CP (% DM) included Germ (16.3), Bran (13.5), High Protein Dried Distillers Grains (HPDDGS; 47.2), Dried Distillers Grains (DDGS1; 30.1), Dried Distillers Grains (DDGS2; 28.9), Wet Corn Gluten Feed (WCGF; 26.7), and Wet Distillers Grains (WDGS; 29.9). Two ruminally and duodenally fistulated Holstein steers averaging 665 kg were used to determine RUP and dRUP. Samples of each feed were ruminally incubated for 16 hours. After simulated abomasal digestion, designated samples were inserted into the duodenum and collected in the feces. Protein fractions A, B1, B2, B3, and C are characterized as follows (% CP): Germ = 30.0, 15.0, 38.1, 13.5, 3.4; Bran = 33.5, 4.0, 54.3, 6.0, 2.2; HPDDGS = 7.4, 0.6, 82.4, 8.8, 0.8; DDGS1 = 17.0, 7.0, 67.0, 4.8, 4.2; DDGS2 = 17.9, 2.1, 41.0, 11.1, 27.9; WCGF = 36.6, 15.9, 33.2, 10.1, 4.1; and WDGS = 18.6, 2.4, 53.1, 11.0, 14.9. The proportions of RUP ($P < 0.01$) and dRUP ($P < 0.01$) were different and are reported as follows (% CP): Germ = 16.5, 66.8; Bran = 20.7, 65.8; HPDDGS = 55.2, 97.7; DDGS1 = 33.2, 92.0; DDGS2 = 56.3, 91.9; WCGF = 11.5, 51.0; and WDGS = 44.7, 93.1. The concentrations of Lys ($P < 0.01$) and Met ($P < 0.10$) in the RUP were different and are listed as follows (%CP): Germ = 2.9, 1.9; Bran = 3.2, 1.4; HPDDGS = 2.0, 3.2; DDGS1 = 1.9, 2.0; DDGS2 = 1.9, 2.4; WCGF = 3.5, 1.6; and WDGS = 1.9, 2.3. Comparison of the co-products defined differences in protein fractions, RUP, dRUP, and post-ruminal Lys supply.

Key Words: Protein, Dairy, Co-Products

T343 Evaluation of ruminal fermentability of corn milling co-products using in vitro gas production. P. J. Kononoff*[1], L. O. Tedeschi[2], M. L. Chizzotti[2], J. M. Kelzer[1], K. Karges[3], and M. L. Gibson[3], [1]*University of Nebraska*, *Lincoln*, [2]*Texas A & M University*, *College Station*, [3]*Dakota Gold Research Association*, *Sioux Falls, SD*.

The kinetics of ruminal fermentation influences the feeding value of corn milling co-products. The objective of this study was to evaluate kinetics of gas production in vitro and fermentability of 7 corn milling co-products. For each feed, the concentration of NDF with sodium sulfite, lignin, starch, and sugar (%DM) were: Germ = 30.1, 4.4, 28.8, 9.2 %, Bran = 21.2, 2.85, 32.0, 5.0 %, High Protein Corn Distillers Grains (HPDDGS) = 22.5, 4.55, 9.50, 0.85 %, Dried Distillers Grains (DDGS1) = 30.2, 4.4, 7.4, 3.5 %, Dried Distillers Grains (DDGS2) = 33.9, 10.1, 6.9, 4.8 %, Wet Corn Gluten Feed (WCGF) = 36.9, 3.2, 9.8, 4.5 %, and Wet Distillers Grains (WDGS) = 30.8, 5.9, 3.7, 3.0 %. Feed samples (200 mg each) were inoculated with rumen fluid and media in an anaerobic condition and fermented in vitro for 48 h. Gas production was continuously measured using a computerized system and data was fitted to an exponential model: $y = a \times (1 - \text{Exp}(-b \times (\text{time} - c)))$, where y = gas production (ml), a is the asymptote of gas

production (ml), b is the rate of degradation (1/h), and c is the lag time. The asymptote (a) of gas production was different among feeds (P = 0.04), with a mean and SEM of 52.1 ± 3.9 ml for Germ, 50.1 ± 3.4 ml for Bran, 37.5 ± 3.4 ml for HPDDGS, 38.6 ± 3.4 ml for DDGS1, 40.1 ± 3.0 ml for DDGS2, 39.0 ± 3.4 ml for WCGF, and 40.7 ± 3.4 ml for WDGS. The lag (c) of gas production was not different among feeds (P = 0.15), with a mean and SEM of 1.42 ± 0.34 h for Germ, 1.25 ± 0.29 h for Bran, 0.65 ± 0.30 h for HPDDGS, 0.38 ± 0.30 h for DDGS1, 0.60 ± 0.27 h for DDGS2, 0.89 ± 0.30 h for WCGF, and 0.35 ± 0.30 h for WDGS. Fractional gas production rates (b) were significantly different among feeds (P < 0.01), with a mean and SEM of 19.3 ± 1.8 for Germ, 16.2 ± 1.5 for Bran, 16.1 ± 1.5 for HPDDGS, 14.6 ± 1.5 for DDGS1, 10.3 ± 1.4 for DDGS2, 11.9 ± 1.5 for WCGF, and 9.1 ± 1.5 for WDGS. Results of this study demonstrate that corn milling co-products differ in chemical composition and that differences also exist in the pattern of ruminal fermentation and nutrient availability.

Key Words: Gas Production, Rumen Fermentation, Corn Milling Co-products

T344 Blood metabolites profiles of dairy cows fed wet corn distillers grains during early lactation. G. S. Mpapho*, A. R. Hippen, K. F. Kalscheur, and D. J. Schingoethe, *South Dakota State University*, *Brookings*.

Multiparous Brown Swiss (n=16), and Holstein (n=18) cows were used in a randomized complete block design to evaluate glucose, cholesterol, and blood urea nitrogen (BUN) concentrations for cows fed wet distillers grains (WDG) at 15% of diet dry matter during early lactation. Cows were paired during the close up period by breed and anticipated calving date and randomly assigned to 1) Control (CON): containing 0% WDG and 2) WDG included at 15% of diet dry matter. Energy density and crude protein content of diets were 1.44 and 1.58 Mcal NEl/kg and 14.5 and 17.2 % for pre- and postpartum diets, respectively, and were similar for CON and WDG. Prepartum diets were fed from 28 d until calving whereas postpartum diets were fed from calving to 70 days in milk (DIM). Diets were offered for ad–libitum intake. Blood was sampled approximately 4 h after feeding at 4, 7, 14, 21, 28, 35, 42, 49 and 56 DIM. Blood samples were analyzed for glucose, cholesterol, and BUN. Dry matter intake (DMI) and energy corrected milk (ECM) for cows fed WDG and CON were unaffected by dietary treatments during the first 70 DIM (23.2 vs 22.5 kg/d; P = 0.46 and 40.1 vs 41.6 kg/d; P = 0.41), respectively. Cows fed WDG had greater glucose concentration (P < 0.05) than those fed CON (64.4 and 60.0 mg/dL). Glucose concentrations in the blood were greater in Holstein than Brown Swiss cows (64.7 and 59.7 mg/dL; P = 0.04). Glucose also varied by DIM with lowest concentrations at 21 DIM (57.6 mg/dL) and greatest at 49 DIM (71.2 mg/dL). Plasma cholesterol was not affected by treatment (114.9 and 118.7 mg/dL; P = 0.74) for both the WDG and CON, respectively. Cholesterol varied by DIM with lowest concentrations at 4 DIM (104.2 mg/dL) and greatest at 56 DIM (137.9 mg/dL). BUN was affected by diet (13.8 and 12.1 mg/dL; P = 0.04), for WDG and CON. No interactions of diet and other main effects were observed for glucose, cholesterol and BUN. Relative to CON, feeding WDG at 15% of ration DM led to a more favorable metabolic profile postpartum as evidenced by increased concentrations of plasma glucose in early lactation.

Key Words: Distillers Grains, Glucose, Cholesterol

T345 Rumen fermentation with dried distillers grains versus soybean protein as a source of rumen undegraded protein for lactating dairy cows. B. W. Pamp*, K. K. Kalscheur, A. R. Hippen, and D. J. Schingoethe, *South Dakota State University*, *Brookings*.

The objective of this research was to evaluate the effect of level and source of rumen-undegraded protein (RUP) on lactation performance and rumen fermentation. Evaluation of source of RUP was accomplished by comparing dried corn distillers grains with solubles (DDGS) to soybean protein. Five ruminally cannulated Holstein cows (122 ± 45 DIM) were used in a 5 × 5 Latin square with 28 d periods. Diets were formulated to provide 3 concentrations of dietary RUP (% of DM) from 2 different sources: 1) 5.3% RUP (control), 2) 6.8% RUP from soybean protein, 3) 6.8% RUP from DDGS, 4) 8.3% RUP from soybean protein, and 5) 8.3% RUP from DDGS. All diets were formulated to contain 10% RDP. Diets consisted of 38.5% corn silage, 16.5% alfalfa hay, and 45% concentrate (DM basis). DMI increased (P < 0.05) with the addition of supplemental RUP (21.0, 21.7, 22.6, 22.7, and 23.1 kg/d). Milk production was greater (P < 0.01) for cows fed diets containing DDGS vs. soybean protein (31.8, 32.3, 34.8, 32.6, and 36.7 kg/d). Protein yield increased (P < 0.01) when soy protein was replaced with DDGS (0.86, 0.86, 0.94, 0.87, and 0.99 kg/d). MUN increased (P < 0.01) as dietary RUP increased (13.6, 15.1, 14.9, 19.0, and 18.7 mg/dl). Increasing dietary RUP increased (P < 0.01) ruminal NH_3 concentrations (4.76, 5.19, 5.39, 6.75, and 5.66 mg/dl). Ruminal concentrations of propionate decreased (P < 0.01) when soy protein was replaced with DDGS and increased (P < 0.01) when the dietary RUP concentration was increased (22.1, 26.0, 23.1, 23.9, and 23.2 mg/dl). Concentrations of butyrate in the rumen increased (P < 0.01) when DDGS replaced soy protein (11.2, 10.9, 12.1, 11.3, and 13.0 mg/dl). The ratio of acetate to propionate increased (P < 0.01) when DDGS replaced soy protein. Increasing RUP in the form of DDGS increased milk production and NH_3 concentrations but decreased propionate concentrations to a greater extent than RUP supplied by soybean protein.

Key Words: Dried Distillers Grains, Soybean Protein, Rumen Fermentation

T346 Effects of alcohol-fermented feedstuff supplemented with chitooligosaccharide on growth performance, blood metabolites and meat composition of Korean steers. B. K. Park[1], I. S. Yuh*[2], S. K. Hwang[2], B. J. Hong[2], and J. S. Shin[2], [1]*National Livestock Research Institute, Rural Development Administration*, *Pyeongchang, Korea*, [2]*College of Animal Life Sciences, Kangwon National University*, *Chuncheon, Korea*.

Fifty Korean steers (average body weight=592.0±45.8kg) were used in the experiment to determine the effects of supplementing chitooligosaccharide (COS) on growth performance, blood metabolites and meat composition in Korean steers fed alcohol-fermented feedstuff (AFF). Steers were randomly assigned to feeding groups of AFF without COS (T1), AFF supplemented with 0.01% of COS (T2), AFF supplemented with 0.02 % of COS (T3), AFF supplemented with 0.05 % of COS (T4), and AFF supplemented with 0.1 % of COS (T5). Average daily gain (ADG) was lower in T5 than in T1 (p<0.05). Concentration of blood albumin was lower in T2 than in the other treatments (p<0.05). Concentration of blood glucose was lower in T1 than in the other treatments (p<0.05). Concentrations of blood low density lipoprotein (LDL)-cholesterol and triglyceride were lower in

T4 than in T1 ($p<0.05$). Back fat thickness was higher in T2 than in T1 or T5 ($p<0.05$). Longissmus muscle area was higher in T5 than in T1 ($p<0.05$). Marbling score, meat color, fat color, maturity, and texture were similar between treatments ($p>0.05$). Protein content of longissmus muscle was higher in T4 than in T3 or T5 ($p<0.05$). Cholesterol and linolenic acid contents of longissmus muscle were higher in T1 than in the other treatments ($p<0.05$). Arachidonic and docosahexanoic acid contents of longissmus muscle were higher in T5 than in T1 ($p<0.05$). Lightness among surface colors of longissimus muscle was lower in T1 than in T5 ($p<0.05$), and hue angle was lower in T1 than in the other treatments ($p<0.05$). Present results indicate that 0.05 or 0.1% supplementation of COS to AFF is more favorable in terms of blood metabolite, carcass characteristics and composition, and surface color of longissimus muscle.

Key Words: Alcohol-fermented Feedstuff, Chitooligosaccharide, Korean Steers

T347 Effects of added yeast culture on lactating dairy cows with subacute ruminal acidosis. M. S. Douglas*, O. AlZalhal, S. L. Greenwood, M. Or-Rashid, and B. W. McBride, *University of Guelph*, *Guelph, Ontario, Canada*.

Of the many challenges today's dairy producers face, subacute ruminal acidosis (SARA) is of increasing concern as producers try to maximize production with higher grain diets. It was hypothesized that inclusion of a yeast culture (Diamond V XP, Yeast Culture, Diamond V, Cedar Rapids, Iowa) *Saccharomyces cerevisiae (S. cerevisae)* in the diet would have a stabilizing affect on the animals' rumen pH and DMI (dry matter intake). The objective of the study was to examine the effect of SARA and added yeast culture interaction on rumen pH, DMI and milk yield. Six multiparous, ruminally fistulated Holstein cows (639 + 51 kg BW) were blocked by DIM (early, moderate and late) and then randomly assigned to a SARA diet (n=3) or control diet (n=3). The trial consisted of 2 weeks pre-yeast followed by 2 weeks of 112g yeast addition into the rumen through the fistula. Ruminal pH was continuously recorded, milk samples were taken 3 d/wk and milk yield and DMI were recorded daily. Data were averaged by week and analyzed by yeast addition using PROC MIXED of SAS with repeated measures where the effect of yeast addition was tested by the contrast describing the time (wk) and time by diet interaction. The results show no effect of week or week by diet interaction on mean rumen pH, time spent below pH 6.0, 5.8 and 5.6, DMI or milk yield.

Table 1. The effect of yeast culture on ruminal pH, dry matter intake, and milk yield in Holstein dairy cows.

	Control		SARA			P Value		
Item/wk	1	2	1	2	SEM	Diet	wk	wk x Diet
Mean pH	6.11	6.06	5.77	5.85	0.05	0.03	0.78	0.32
< 6.0, min/d	509	614	1055	1007	63.51	0.02	0.64	0.25
< 5.8, min/d	253	259	630	638	58.15	0.02	0.92	0.99
< 5.6, min/d	97	104	368	283	86.22	0.14	0.64	0.59
DMI, kg/d	21.9	22.2	24.5	25.0	1.5	0.33	0.43	0.75
Milk, kg/d	32.8	32.8	32.1	32.5	6.06	0.96	0.71	0.71

Key Words: Yeast Culture, SARA, Rumen pH

T348 Effect of feeding system on lactation characteristics and milk components in dairy cattle. M.-C. Ferland*[1], D. Lefebvre[2], and K. M. Wade[1], [1]*McGill University*, *Montreal, QC, Canada*, [2]*Valacta*, *Ste. Anne de Bellevue, QC, Canada*.

The objective of this study was to evaluate the effect of two different feeding systems on the milk composition of dairy cattle. A total 9,163,240 test-day records from 570,083 Holstein cows from 5191 different herds, and 434,018 test-day records from 27,110 Ayrshire cows from 652 different herds covering a period of five years were obtained from the Québec dairy herd improvement agency (Valacta). In addition to test-day records, information on lactation, feed composition and feeding systems was also available. For both Ayrshire and Holstein cows the feeding system had an effect on milk yield and milk urea nitrogen (MUN) concentration on a test-day basis. Cows served a diet prepared with a Total mixed ration (TMR) compared to cows served a diet in a Traditional way (TRAD) tended to produce more milk. Average milk yields for Holsteins in the respective feeding systems were 26.29 kg/day and 29.28 kg/day; the equivalent values for Ayrshire were 21.44 kg/day and 23.23 kg/day. Peak milk yield for cows fed TRAD was generally lower and achieved earlier in lactation (45 - 60 DIM) compared to cows fed TMR (60 - 75 DIM). Lower MUN concentrations were observed when cows were fed TMR compared to TRAD. Holstein averages were 11.45 mg/dL and 10.61 mg/dL while Ayrshire averages were 12.40 mg/dL and 11.04 mg/dL for TRAD and TMR respectively. Over the lactation period the differences in MUN concentration between TMR fed and TRAD fed cows are even more pronounced beyond 30 DIM. Ayrshire cows also displayed a small difference in milk protein content between the two types of feeding system. TRAD fed cows had lower milk protein content (3.40%) compared to TMR fed cows (3.45%) but when milk protein content was observed over the lactation period, greater differences were observed beyond 90 DIM. When the lactose content of Holstein test-day records was studied over the lactation period, TMR fed cows had a better persistency of lactose content than TRAD fed cows after 90 DIM although the average lactose content only showed small numerical differences (4.52% and 4.57% for TRAD and TMR respectively).

Key Words: Dairy Feeding System, Milk Urea Nitrogen, Milk Components

T349 Effect of rumen protected choline (Reashure®) and rumen protected methionine on milk yield, and composition in lactating dairy cows. S. Emanuele*[1], T. Hickley[1], and R. Carvalho Bicalho[2], [1]*Balchem*, *New Hampton, NY*, [2]*Cornell University*, *Ithaca, NY*.

Holstein cows were used to evaluate the impact of rumen protected choline (Reashure®), (18 g/cow/day) and rumen protected methionine (Smartamine®), (18 g/cow/day) on milk yield and composition in a well-managed commercial herd. Experimental treatments were 1) control, no rumen protected choline or methionine, 2) rumen protected methionine (RPMET) and 3) rumen protected choline (RPC). Cows were assigned to treatment groups based on DIM and parity. The experimental period was 10 weeks which included a 2 week pretrial covariate period. DIM at the start of the trial were 224, 212 and 217 for control, RPMET and RPC treatments. Diets were formulated using CNCPS model software. Lysine and methionine as a percent of metabolizable protein (MP) was estimated using CNCPS software and was 7.17 and 2.03% in control and RPC diets. Lysine and methionine as a percent of MP in the RPMET diet was 7.12 and 2.41%. Weekly

averages for milk yield data were analyzed using the mixed model procedure of SAS (SAS Institute, Inc., Cary, NC). Covariates used in the analysis were pretrial milk yield, parity and DIM. Supplementing rumen protected choline (RPC) to late lactation cows increased milk yield compared to RPMET (P<0.05). There was a trend for increased milk fat % on the RPC treatment (P<0.09). Supplementing RPMET increased milk protein % compared to RPC (P< 0.05). There was no difference among treatments for milk protein yield. Actual milk fat yield was increased 4.9% on RPC treatment compared to control. Milk income per cow was increased by 2.5% when RPC was fed to late lactation cows.

Table 1. Effect of treatments on animal performance

Item	Control, n= 254	RPMET, n=263	RPC, n=253	SE
Milk Yield, kg/d	37.6[a]	36.5[b]	38.0[a]	0.57
Milk Fat, %	3.60[e]	3.54[e]	3.70[d]	0.04
Milk Protein, %	3.06[a]	3.10[a]	3.00[b]	0.02
Milk fat yield, lbs./d	2.86	2.83	3.00	
Milk Income per cow, $	10.01	10.10	10.26	

[ab]Values in the same row with different superscripts are different (P<0.05) [de]Values in the same row with different supercripts are different (P<0.09)

Key Words: Choline, Methionine, Dairy

T350 Effects of choline and rumen protected choline (Reashure®) on milk production, milk composition and blood metabolites of lactating dairy cows. A. Toghdory[1], S. Emanuele*[2], T. Ghoorchi[3], and A. Naserian[4], [1]*Islamic Azad University*, *Gorgan, Iran*, [2]*Balchem Corporation*, *New Hampton, NY*, [3]*Gorgan University of Agricultural Sciences*, *Gorgan, Iran*, [4]*Ferdowsy University*, *Mashhad, Iran*.

Eight multiparous Holstein cows with an average milk production of 34.6 kg/d and body weight of 662.5 kg were used to evaluate the effect of choline chloride or rumen protected choline (Reashure®) on animal performance. The experimental design was a 4X4 Latin Square with 21 day periods. Experimental treatments were: 1) no choline (NC), 2) choline chloride (CC) fed at 50 g/d, 3) rumen protected choline (RPC 25) fed at 25 g/d and 4) rumen protected choline (RPC 50) fed at 50 g/d. Rumen protected choline was blended with 0.25kg of ground corn and fed once per day. Diets contained 17.4% crude protein, 21% ADF, 34% NDF and 41% NFC. Diet content of lysine and methionine as a percent of metabolizable protein was 6.48 and 1.9%, estimated using CPM ration software. Animals were milked three times per day. Milk yield was measured at each milking during the last 7 days of each period. Individual milk samples for component analysis were collected on the last 2 days of each period and pooled from 3 consecutive samples. Dry matter intake as a percentage of body weight was 3.52% and not different among treatments. Supplementing cows with choline chloride did not affect animal performance compared to control. Supplementing cows with rumen protected choline (RPC 50) increased milk yield, 4% FCM, milk fat % and milk fat yield compared to cows not receiving choline.

Table 1. Effect of treatments on animal performance

Item	NC	CC	RPC 25	RPC 50	SE
Milk Yield, kg/d	34.3[b]	34.9[ab]	34.4[ab]	36.0[a]	0.53
4% FCM, kg/d	31.7[b]	31.6[b]	32.7[ab]	34.4[a]	0.74
Milk fat yield, kg/d	1.20[b]	1.17[b]	1.26[ab]	1.33[a]	0.038
Milk protein yield, kg/d	1.03	1.06	1.04	1.09	0.019
Total solids yield, kg/d	4.05[b]	4.02[b]	4.11[ab]	4.31[a]	0.082
Milk fat, %	3.50[ab]	3.37[b]	3.68[a]	3.69[a]	0.089
Milk protein, %	3.02	3.06	3.02	3.03	0.024
Blood Glucose, mg/dl	42.1	44.7	44.1	43.6	1.70

[ab]Values in the same row with different superscripts are different (P<0.05)

Key Words: Choline, Dairy Cow, Reashure

T351 Effect of rumen protected choline (Reashure®) supplemented to high-producing cows on milk production, milk components, and intake. M. B. de Ondarza*[1], S. Emanuele[2], and D. Putnam[2], [1]*Paradox Nutrition*, *West Chazy, NY*, [2]*Balchem Corporation*, *New Hampton, NY*.

The objective of the trial was to determine if feeding a small amount of rumen protected choline to lactating multiparous Holstein cows would affect milk components and milk yield. Half of the cows (n=153) received Reashure® (12.3 g/cow/day) and half did not (n=158) for the four week study. The study was conducted in a well managed commercial herd. Daily pen dry matter intakes were monitored. Daily milk production of individual cows was recorded. Milk was sampled on weeks 3 and 4 of the study and analyzed for milkfat, true protein, SCC, and MUN content. All diets contained Alimet® and monensin. The control diet contained 7.06% lysine and 2.01% methionine as a percent of MP estimated by CPM ration software. Cows fed rumen protected choline consumed significantly less dry matter than control cows (23.00 vs. 23.82 kg/cow/day for Reashure® vs. control cows (P<0.001). Overall milk production was not affected by treatment (P>0.20), 43.92 kg/day and 43.85 kg/day for the Reashure® and control diets. There was no difference due to treatment in 3.5% FCM (P>0.20). However, cows between 101 and 200 DIM produced significantly more 3.5% FCM (P<0.01). Milkfat (%) was affected positively by Reashure® (P=0.011) with 3.63% milkfat for cows fed Reashure® and 3.44% for cows on the control diet. Production of milkfat was increased by treatment with 1.57 kg/day for cows fed Reashure® and 1.49 kg/day for cows fed the control diet (P=0.067). Cows between 101 and 200 DIM produced significantly more milkfat when fed Reashure® (P<0.01). Cows on the Reashure® and control diets produced milk with a similar percentage of true milk protein (2.87% vs. 2.86%, (P>0.20). However there was a trend for greater milk protein % in cows between 0 and 100 DIM, (P<0.09) for cows fed Reashure®. There was no difference among treatments in true milk protein yield, MUN (mg/dl), or SCC (P>0.20). These data suggest that supplementation of rumen protected choline to high-producing cows may improve efficiency of milk production and milkfat synthesis.

Key Words: Rumen-Protected Choline, Milk Production, Reashure

T352 Effects of rumen protected choline during transition phase on metabolic profile and ovarian activity in Italian Friesian dairy cows. F. Abeni[1], M. G. Terzano[2], M. Speroni[1], L. Migliorati[1], P. Cavassini[3], and G. Pirlo*[1], [1]*CRA Istituto Sperimentale per la Zootecnia*, *Cremona, Italy*, [2]*CRA Istituto Sperimentale per la Zootecnia*, *Roma Monterotondo , Italy*, [3]*Ascor Chimici s.r.l*, *Bertinoro, Italy*.

The objective of this paper was to report the effects of supplementation of rumen protected choline (RPC) to transition cows on plasma metabolites and ovarian activity resumption (OAR). Twenty-two Italian Friesian cows were randomly assigned by expected calving date, parity, and previous milk yield to either be supplemented with RPC from d -21 relative to expected parturition until 35 DIM, or to consume basal diet only (CON). Treatment with RPC was obtained adding 50 g of RPC top dressed product (Sta-Chol®, Ascor Chimici, Italy, with 50% choline as choline chloride) per cow, just after TMR distribution. Jugular blood samples were collected before feeding, once just before the trial start, and then weekly until the 10th wk of lactation. Pre and postpartum data were analyzed separately. Effects of treatment were measured on plasma glucose, NEFA, cholesterol, BHBA, triglycerides, and OAR (monitored by plasma progesterone). Statistical analysis was performed by a randomized block design, with supplementation (RPC vs. CON), and week of trial as main factor, with cow repeated in time, while OAR data were analyzed by one-way ANOVA. Cows fed RPC had higher plasma urea (4.06 vs. 3.54 mmol/L; $P<0.05$) during prepartum. Plasma glucose was lower (3.26 vs. 3.52 mmol/L; $P<0.05$) and BHBA was higher (0.496 vs. 0.390 mmol/L; $P<0.05$) in RPC cows at the beginning of lactation, but without differences in clinical signs of ketosis (absent in both groups). Postpartum plasma triglycerides level was higher (0.104 vs. 0.084 mmol/L; $P<0.05$), and there was a trend ($P<0.10$) showing lower plasma values of NEFA and NEFA/cholesterol ratio in RPC cows, reaching significant difference at 4 wk ($P<0.05$) for both items. No significant difference was observed in DIM at OAR. Supplementation with RPC improved metabolic profile of peripartum dairy cows in order to prevent the risk to develop fatty liver syndrome.

Key Words: Choline, Dairy Cow, Metabolic Profile

T353 Effects of rumen protected choline during transition phase on production responses in Italian Friesian dairy cows. F. Abeni[1], M. Speroni[1], M. G. Terzano[2], L. Migliorati[1], P. Cavassini[3], and G. Pirlo*[1], [1]*CRA Istituto Sperimentale per la Zootecnia*, *Cremona, Italy*, [2]*CRA Istituto Sperimentale per la Zootecnia*, *Roma Monterotondo , Italy*, [3]*Ascor Chimici s.r.l*, *Bertinoro, Italy*.

The objective of this paper was to report the effects of supplementation of rumen protected choline (RPC) to transition cows on production responses. Twenty-two Italian Friesian cows were randomly assigned by expected calving date, parity, and previous milk yield to either be supplemented with RPC from d -21 relative to expected parturition until 35 DIM, or to consume basal diet only (CON). Treatment with RPC was obtained by the addition of 50 g RPC top dressed product (Sta-Chol®, Ascor Chimici, Italy, with 50% choline as choline chloride) per cow, just after once daily TMR distribution. Body condition score (BCS) was measured weekly from -21 to +70 DIM. Milk production was automatically recorded at each milking, within an automatic milking system, whereas milk composition was determined every 2 weeks. Statistical analysis was performed by a randomized block design, with supplementation (RPC vs. CON), and time as main factors, with cow repeated in time; BCS variation was analyzed as a simple one-way ANOVA. Milk production (34.8 vs. 29.9 kg/d; $P<0.001$), ECM (34.9 vs. 31.1 kg/d; $P<0.01$), fat yield (1.26 vs. 1.11 kg/d; $P<0.05$), and protein yield (1.10 vs. 1.00 kg/d; $P<0.05$) were higher for the RPC group, whereas no significant differences between treatments were evidenced in fat and protein content. Prepartum BCS was lower in the RPC group (3.27 vs. 3.49; $P<0.01$); however, BCS variation throughout the treatment period (-21 to 35 d relative to calving date) had a trend to be higher in the RPC group (0.83 vs. 0.61; $P=0.14$). The differences in BCS variation suggest a better management of body fat reserves in the transition phase of RPC cows. From the results obtained in the present trial, on a small number of cows, peripartal supplementation of RPC at the considered level seems to improve productive performance in an extent which encourages further studies on a larger number of cows.

Key Words: Choline, Dairy Cow, Milk Yield

T354 Effects of feeding rumen-protected choline (RPC) on health and reproduction of dairy cows. F. S. Lima*[1], M. F. Sa Filho[1], J. E. Garrett[2], and J. E. P. Santos[1], [1]*Veterinary Medicine Teaching and Research Center, University of California Davis*, *Tulare*, [2]*Balchem Corporation, Animal Health & Nutrition*, *New Hampton, NY*.

Objectives were to determine the effects of feeding RPC on health and reproduction in dairy cows. In Experiment 1 (E1), 369 cows were fed 15 g/d of RPC (Reashure, Balchem Encapsulates) from 25 d before calving to 80 d in milk (DIM). In E2, 578 primigravid cows were fed 15 g/d of RPC in the 21 d before calving. Health of cows was monitored daily in the first 80 DIM by the research team in E1 and by farm personnel in E2, both following the same disease case definitions. Cows were presynchronized with 2 injections of PGF2a given 14 d apart and then subjected to a timed AI using the CoSynch protocol (d 0, GnRH, d 7, PGF2a, d 10 GnRH and timed AI) initiated either 10 or 14 d after the second PGF2a for E1 and E2, respectively. Data were analyzed using the Logistic procedure of SAS (2001). In E1, feeding RPC reduced ($P<0.05$) the incidence of ketonuria (10.7 vs 28.8%), clinical ketosis (4.0 vs 11.3%), and relapse of clinical ketosis (2.3 vs 6.8%). Incidence of retained placenta, postpartum fever, puerperal metritis, metritis and displacement of abomasum did not differ ($P>0.10$) between treatments, but mastitis was reduced ($P=0.06$) in cows fed RPC compared with controls (14.8 vs 22.5%), and cows fed RPC experienced fewer ($P=0.04$) cases of mastitis (0.19 vs 0.33/cow). Cyclicity prior to the CoSynch protocol was similar ($P=0.67$) between treatments and averaged 81.7%. Conception rates at first (48.2 vs 41.2%; $P=0.20$) and second postpartum AI (23.7 vs 19.8%; $P=0.47$) did not differ between RPC and control. In E2, RPC did not affect ($P=0.41$) incidence of clinical ketosis (7.0 vs 3.7%), reduced ($P=0.02$) the incidence of retained placenta (2.1 vs 6.7%), but more ($P<0.02$) RPC cows experienced postpartum fever (17.2 vs 11.4%) and metritis (35.4 vs 21.8%) than controls. Conception rates at first (50.6 vs 50.8%; $P=0.83$) and second AI (38.8 vs 46.4%; $P=0.49$) were similar between RPC and control. Feeding RPC prior to and after calving improved postpartum health, but did not significantly influence uterine health or reproductive performance of dairy cows. When fed only prepartum to primigravid cows, RPC had mixed effects on health, but did not influence reproduction.

Key Words: Choline, Dairy Cow, Reproduction

T355 Interrelationships of dietary supplies of choline and methionine on productive performance of Holstein dairy cows. B. J. Thering*[1], J. M. Ramos-Nieves[1], J. L. Lukas[1], D. E. Putnam[2], and T. R. Overton[1], [1]*Cornell University*, *Ithaca, NY*, [2]*Balchem Encapsulates*, *New Hampton, NY*.

Holstein dairy cows (n=60) in early lactation were used to investigate the interrelationships between dietary supplies of choline and methionine (Met) on productive performance. During wk 11 of lactation, cows (n=10 multiparous and n=5 primiparous) were assigned to one of four dietary treatments in a completely randomized design with a 2 x 2 factorial arrangement of treatments. Main effects were supplementation with 0 or 15 g/d of rumen-protected choline (Reashure™, Balchem Encapsulates, New Hampton, NY) and 0 or 14 g/d of rumen-protected Met (Mepron M85, Degussa Corporation, Kennesaw, GA). Treatments were administered by daily topdress from wk 11 through 18 of lactation. Cows were fed a diet formulated to supply Met and Lys at 1.94 and 6.79% of metabolizable protein, respectively. Covariate data collected during wk 10 of lactation was used during statistical analysis of all variables. Dry matter intake (25.4, 25.0, 25.4, and 25.4 kg/d for control, choline, Met, and choline+Met, respectively) and milk yield (43.7, 44.1, 44.5, 44.1 kg/d) were not affected ($P > 0.60$) by treatment. Supplementation with Met tended ($P < 0.09$) to decrease milk fat percentage (3.68 vs. 3.55%) and supplementation with choline tended ($P < 0.06$) to decrease milk true protein percentage (2.86 vs. 2.82%). Percentages of lactose and total solids in milk were not affected ($P > 0.13$) by treatment. Yields of milk components were not affected ($P > 0.24$) by treatment. Supplementation with choline tended ($P < 0.10$) to increase concentrations of milk urea N (13.1 vs. 13.6 mg/dL). Body weight and body condition score were not affected ($P > 0.19$) by treatment. Interactions of parity with either the main effects or the interaction of the main effects were not significant ($P > 0.10$) for any variable. Overall, supplementation with either choline or methionine resulted in only minor effects on productive performance; interactions of choline and methionine were not evident for any of the variables studied in this experiment.

Key Words: Dairy Cow, Choline, Methionine

T356 Effects of feeding protected choline on arrival or during Optaflexx feeding on performance or carcass characteristics of feedlot cattle. R. K. Gill*[1], C. R. Dahlen[2], N. DiLorenzo[1], and A. DiCostanzo[1], [1]*University of Minnesota*, *St. Paul*, [2]*University of Minnesota Northwest Research & Outreach Center*, *Crookston*.

One hundred eighty seven crossbred yearling steers (average initial BW = 306 kg) were allocated to 16 pens (9 to 14 steers/pen) to evaluate the effects of feeding ruminally protected choline (**RPC**) on arrival or during Optaflexx feeding on performance and carcass characteristics. Steers were fed a finishing diet based on corn silage (13.0 %), high moisture corn (63.5 %), dry rolled corn (18.0 %), and mineral supplement (5.5 %) on a DM basis. Pens were randomly assigned to one of four dietary treatments: 1) no RPC added in the protein supplement (**Control**), 2) feeding 20 g RPC/hd/d in the protein supplement from d 1 to d 42 (**Initial 42**), 3) feeding 20 g RPC/hd/d during the last 28 to 42 d on feed (**Final 42**), or 4) or feeding 20 g RPC during both the initial 42 d and final 28 to 42 d on feed (**Both**). All dietary treatments received the ß-agonist Optaflexx during the final 28 to 42 d on feed. Dry matter intake (9.81 ± 0.26 kg/d), ADG (1.87 ± 0.03 kg/d), and G:F (0.19 ± 0.07 kg) were unaffected by dietary treatment ($P > 0.05$). Hot carcass weight, dressing percentage, KPH, fat thickness, and rib eye area were also unaffected by dietary treatment ($P > 0.05$). Carcasses from steers of all treatments were, on average, low choice quality grade with average yield grade 2.0. Previous research has demonstrated that optimum performance with RPC occurs with 20 g of RPC supplementation daily. Further research is warranted to test duration of RPC supplementation during the finishing period alone or in combination with β-agonists.

Key Words: Choline, Feedlot Cattle, Performance

T357 Field studies adding dl-methionine hydroxy analogue calcium to lactation cow rations. D. Nuzback*[1], G. Bowen[1], R. Anderson[1], M. Vazquez-Anon[1], and M. Hutjens[2], [1]*Novus International*, *St.Louis, MO*, [2]*University of Illinois*, *Urbana*.

Four commercial high producing herds (Dairy A, a MN herd; Dairy B, a WI herd; Dairies C and D, IL herds) were supplemented with 25 grams per cow per day of the calcium salt of 2-hydroxy-4- methylthio butanoic acid (84 % HMTBa; MFP ^TM^, Novus International, Inc.), a source of methionine. The experimental design included a pre-treatment period, a treatment period (treat) of 90 days, and a post-treatment period. Milk production data were collected using PC DART or Dairy Comp 305 record systems with the pre- and post-treatment data averaged for the control period. A total of 1,938 cows met the experimental criteria (milk production data from Oct., 2005 to June, 2006). SAS statistical software was used to evaluate the treatment differences. Cows in the four herds receiving HMTBa produced 1.96 kg more milk per cow ($P = 0.01$), averaging 41.8 kg (treat) while control cows averaged 39.9 kg. Milk protein yield was increased by 52 grams per day in the supplemented cows compared to the controls ($P < 0.01$). Control cows averaged 1,185 grams of protein compared to supplemented cows yielding 1,237 grams of milk protein. Milk fat yield increased, but was not significantly different. Table 1 summarizes individual farm milk production responses. The economic benefit was a 5:1 benefit to cost ratio based on $12 per 45 kg of milk and a 10 cent investment for HMTBa.

Table 1. Milk production yield response by herd

Dairy	Herd Size (total)	Cows (included)	Control (kg/cow)	Treat (kg/cow)	SE (+/-)
A	1400	1005	41.9	43.9	0.19
B	1250	782	39.9	41.0	0.18
C	150	119	39.1	41.1	0.48
D	70	32	38.4	41.1	1.03

Key Words: Amino Acid, Milk Yield, Milk Protein

T358 Influence of dietary protein on growth, fluoride kinetics and radiology of long bones of crossbred calves exposed to high fluoride diets. J. D. Lohakare*[2,1], A. K. Pattanaik[2], and S. A. Khan[2], [1]*University of Bonn*, *Bonn, Germany*, [2]*Indian Veterinary Research Institute*, *Izatnagar, India*.

Effects of dietary protein levels on the performance of crossbred calves exposed to high fluoride diets were investigated. Accordingly, 30

crossbred calves (6-8 months) were distributed randomly into a 2×3 factorial arrangement involving two levels of dietary fluorine (F; 0 and 200 mg/kg), and three levels of dietary protein (CP; 100, 75 and 125 % of Kearl recommendation). All the calves were fed on a standard diet consisting of concentrate mixture and ad libitum wheat straw. There was daily recording of dry matter intake as well as fortnightly monitoring of live weight changes. A metabolism trial was conducted towards the end of the 210 days of experimental feeding to assess the fluoride kinetics. The results revealed that average daily gain of the calves was significantly (P<0.05) influenced by both dietary CP as well as F levels, being lower on low protein (319±50.4 vs. 400±27.0 and 407±34.5g) and high F (289±27.9 vs. 462±17.1g), respectively. Similar was the case in terms of feed conversion efficiency; it was lower (P<0.05) upon low CP and high F feeding. Moreover, a significant interaction between F and CP indicated a lower (P<0.05) feed efficiency when F was added to low CP diet. The mean daily intake, excretion and retention of F were higher (P<0.01) in the F supplemented calves. No effect of dietary protein levels was apparent on fecal fluoride excretion. A significant (P<0.01) interaction between protein and F levels was evident in the urinary excretion of F; calves on low protein diet exhibiting lower urinary excretion. Consequently, the bioavailability of F tended to be higher on low than normal or high protein diets. Lateral radiographs of metacarpal and metatarsal bones taken at 90 and 210 days of the study revealed significant effects of high fluoride diet on bone width, cortical thickness and medullary cavity but without any influence of dietary protein levels. Overall, it is concluded that while feeding of high CP did not exert appreciable protective effects, provision of low CP diet aggravated the performance-reducing effects of high fluoride diet.

Key Words: Fluorine, Protein, Calves

T359 Organic selenium (Sel-Plex®) improves selenium content in milk and cheese of dairy goats. G. Caja*[1], C. Flores[1], A. A. K. Salama[1], J. Saldo[1], and G. Bertin[2], [1]*Universitat Autònoma de Barcelona*, *Bellaterra, Spain*, [2]*Alltech France*, *Levallois-Perret, France*.

Thirty Murciano-Granadina dairy goats were used to study the lactational effects of inorganic Se (SS, selenium selenite, Na2SeO3) and organic Se from selenized Saccharomyces cerevisiae CNCM I-3060 (SP, Sel-Plex®, Alltech) in a source and dose response experiment. Goats were allocated to 4 balanced groups to which dietary treatments were randomly assigned: control (without Se supplement, C), inorganic (0.3 mg Se as Na2SeO3, SS-0.3), and 2 doses of organic selenium (0.3 mg and 0.45 mg Se as Sel-Plex®; SP-0.3 and SP-0.45, respectively). Concentrate mixture (0.8 kg/d), in which Se source was included, was fed individually. Forage diet (65% chopped tall fescue hay and 35% alfalfa hay pellets) was offered ad libitum for each group. The experiment lasted for 30 wk (wk 6 to 35 of lactation) and included a covariate period (P1, wk 1 to 2) on C diet, supplementation period (P2, wk 3 to 18), and washing out period (P3, wk 19 to 30) again on C diet. Milk yield was recorded weekly, and samples for milk composition analysis and technological dairy traits evaluation were taken biweekly. Milk was bulked for each group at wk 18 for cheese making. Milk (Se content) and blood (haematological and biochemical analysis) sampling was done at wk 2, 3, 4, 8, 12, 16, 18, 24, and 30. No differences in DM intake, milk yield or milk quality traits were detected between treatments. Concentrations of Se in milk varied (P < 0.001) between treatments during p2 and were 8.8, 13.8, 19.5, and 39.7 µg/l for c, ss-0.3, sp-0.3, and sp-0.45, respectively. during p1 and p3, there were no differences between treatments in milk se (4.9 and 7.8 µg/L, respectively). During P2, Se and glutathione peroxidase (GPX) concentrations in blood increased (P < 0.01) by Se supplementation with no difference between SS-0.3 and SP-0.3 and SP-0.45 values being the highest (P < 0.01). Concentrations of Se in fresh cheese were 61, 99, 160, and 368 µg/kg in C, SS-0.3, SP-0.3, and SP-0.45, respectively. In conclusion, organic Se was more effective than inorganic Se in increasing the concentration of Se in milk and cheese in dairy goats, indicating an improved bioavailability of Se from selenized Saccharomyces cerevisiae CNCM I-3060.

Key Words: Organic Selenium, Dairy Goats, Mineral Nutrition

T360 Utilization of TRC Nutritional Laboratories trace mineral compost for growing and finishing beef cattle. D. R. ZoBell*, J. O. Hall, R. D. Wiedmeier, and C. K. Chapman, *Utah State University*, *Logan*.

The objectives of this study were to determine the effect of TRC Trace Mineral Compost Material (TMCM) on production characteristics and whole body mineral status of growing and finishing beef cattle. A total of 45 British-based crossbred steer calves (initial wt. 293 kg) were used during the growing and finishing phases of this study. There were 9 pens with 3 pens per treatment and 5 steers per pen. All calves in the growing (84d) and finishing (140d) studies received a standard barley-based growing (34% barley DMB) or finishing diet (77.3% barley DMB). Treatment consisted of a Control (C), Treatment 1 (T1) and Treatment 2 (T2). All calves received .045 kg of limestone per day during the finishing phase and 50,000 IU Vit A for the growing and finishing periods. The C calves received .045 kg d-1 of a standard TM salt; T1 calves .022 kg d-1 of salt (99%) and .07 kg d-1 of TMCM; T2 calves received .022 kg d-1 of salt and .14 kg d-1 of TMCM. True cut liver biopsy samples were collected from all calves at the beginning of the growing and finishing studies and at trial termination to monitor levels of Ca, Co, Cu, Fe, Mg, Mn, P, K, Se, Na and Zn. There were no differences between treatments for DMI, ADG, FE or carcass characteristics during growing or finishing (P>0.05). Generally, the treatments resulted in an increase in liver mineral levels as the study progressed through growing and finishing (P<0.05). However, Se and Co were low initially and remained so through finishing for T1 and T2 calves (P<0.05). The results indicated that feeding TMCM did not adversely affect production through all phases of production.

Key Words: Minerals, Beef Cattle, Liver

T361 Influence of chromium supplementation during growing period on performance of Brahman cross bull calves. R. Barajas*[1], E. A. Velazquez[1], B. J. Cervantes[2,1], F. Juarez[1], and J. A. Romo[1], [1]*FMVZ-Universidad Autonoma de Sinaloa*, *Culiacan, Sinaloa, Mexico*, [2]*Ganadera Los Migueles SA de CV*, *Culiacan, Sinaloa, Mexico*.

Sixty Brahman cross bull calves (BW = 244 ± 2.2kg) were used in a 91 d feedlot experiment to determine the influence of chromium supplementation during the growing period on performance of Brahman cross bull calves. Bull calves were received in a big pen (35 × 45 m) and fed a corn silage-based diet and rested 10 d, after that the animals

receive an implant containing estradiol and trenbolone (Component TES with Tylan; Elanco Animal Healt de Mexico). Bull calves were sorted by weight into groups of five, allotted to pens (6 x 12 m) in a randomized block design. Treatments consisted of: 1) corn silage-based starting-diet during the first 28 d and the next 63 d fed a ground corn soybean meal-based growing-diet without supplementary chromium (Control); 2) control diet and 2.2 mg of supplementary Cr/head daily during the first 28 d in the feedlot; or 3) control diet and 2.2 mg of supplementary Cr/head during 91 d of entire experiment. Chromium was supplied as chromium methionine (MiCrOPLEX; Zinpro Co) mixed in 1 kg of ground corn and top dressed in the feed bunk. During the 28 d of receiving period Cr supplementation had no effect (P > 0.25) on average daily gain (1.39 ± .08 kg/d), DMI (6.53 ± .22 kg/d) and feed/gain ratio (4.77 ± .26 kg kg/kg). From d 29 to d 91, cattle performance was not affected (P > 0.6) by treatments. Over the complete 91 d experiment, bull ending weight (384.7 ± 6.66 kg) was similar (P = 0.72) for all treatments. Average daily gain (1.542 ± .07 kg/d) was not affected (P = 0.85) by Cr supplementation. The addition of chromium in the diet did not modify (P > 0.50) DMI (7.197 ± .27 kg/d) or feed/gain ratio (4.68 ± .18 kg/kg). Observed/expected net energy of maintenance was 26% higher than expected from dietary composition and was not altered (P = 0.8) by chromium supplementation. These results suggest that organic chromium supplementation may not be necessary for rested bull calves fed corn silage based-diets.

Key Words: Bull-Calves, Chromium, Growth-Performance

T362 Effects of potassium, alcoholic diet and vitamin E to minimize transport stress in Korean steers. J. S. Shin*[1], B. Y. Choi[1], H. Kim[1], C. S. Ra[1], B. J. Hong[1], J. S. Oh[1], and B. K. Park[2], [1]*College of Animal Life Sciences, Kangwon National University*, *Chuncheon, Korea*, [2]*National Livestock Research Institute, Rural Development Administration*, *Pyeongchang, Korea*.

This study was conducted to compare and evaluate effects of potassium, alcoholic diet, and vitamin E on transport shrinkage, blood metabolites, and meat color from transport stress in Hanwoo steers. Experiments were divided into four treatment groups; control (general feeding system), alcoholic diet (1.58kg/animal/day), potassium (1.45% of total dry matter intake), and vitamin E (500IU/animal/day). And each treatment had ten steers. Transport shrinkage was higher in control than in alcoholic diet, potassium or vitamin E ($p<0.05$). Concentrations of serum creatinine, glucose, total protein, and insulin of control were increased after transport compared with before transport ($p<0.05$). But those of alcoholic diet, potassium, and vitamin E were decreased after transport compared with before transport ($p<0.05$). Concentrations of serum calcium and cortisol were increased after transport compared with before transport regardless of treatments ($p<0.05$). But concentrations of serum inorganic phosphorus and triglyceride were decreased after transport compared with before transport regardless of treatments ($p<0.05$). Meat color were lower in alcoholic diet and vitamin E than in control ($p<0.05$). Fat color, marbling score, back fat thickness, and meat production index were similar between treatments ($p<0.05$). Lightness among surface colors of longissimus muscle was higher in vitamin E than in control ($p<0.05$), and chroma value was lower in control than in alcoholic diet, potassium or vitamin E ($p<0.05$). Therefore, results suggest that transport stress was decreased by alcoholic diet, potassium, or vitamin E. Also, potassium and alcoholic diet are more favorable in terms of transport shrinkage and blood metabolite. And vitamin E has positive effects on meat color and surface colors of longissimus muscle in Korean steers.

Key Words: Transport Shrinkage, Meat Color, Korean Steers

T363 The effects of maternal natural source vitamin E supplementation on suckling calf immune function. M. Richardson*[1], S. Lake[1], P. Gunn[1], S. Eicher[2], R. Lemenager[1], and N. Pyatt[3], [1]*Purdue University*, *West Lafayette, IN*, [2]*USDA-ARS*, *West Lafayette, IN*, [3]*ADM-Animal Nutrition Research*, *Decatur, IN*.

The objective of this study was to determine the effects of maternal supplementation of natural-source vitamin E (NSVE) and a commercially available mixture containing NSVE on suckling calf immune response. Eighty Angus beef cows (initial BW = 608 kg; initial BCS = 5.9) were randomly assigned to one of three isocaloric dietary treatments: 1) corn-based supplement with no added vitamins or minerals (CON), 2) corn-based supplement containing 1000 IU NSVE/d (VITE), and 3) corn-based supplement containing a commercially available mixture formulated to contain 1000 IU of NSVE/d (VITE+). Supplementation began 3 wks prepartum and continued through wk 8 of lactation. Blood was collected from calves at 24 h for analysis of IgG concentration as an indicator of passive transfer. At 19 d of age, blood was collected from calves to determine the presence of CD14 and CD18 receptors on leukocytes. At 25 and 40 d of age, calves were injected with hen egg albumin (OVA) and bled weekly until d 60 of age to determine total antibodies produced to OVA. Maternal NSVE supplementation did not influence (P > 0.05) calf ADG or 24 h IgG concentrations. Calves suckling VITE and VITE+ dams tended to have greater (P = 0.19) CD14 levels than CON calves while CD18 tended to be greater (P = 0.18) in VITE+ than VITE and CON calves. A treatment × day interaction (P < 0.001) was detected for total antibodies produced to OVA. Total antibodies produced at d 14 tended to be greater (P = 0.06) in VITE+ than CON calves, indicating an accelerated response time to the OVA challenge; however, VITE calves had greater (P = 0.05) antibody production to OVA at d 28 than CON calves. In conclusion, maternal NSVE supplementation appeared to improve immune function in suckling calves with an increase in antibodies produced at d 14 and 28 and tended to increase CD14 and 18 receptors; however, calf performance was not affected.

Key Words: Beef Calves, Immune Response, Vitamin E

T364 Effects of a humate product on growth performance, carcass merit, and tissue and serum mineral composition of individually-fed steers. M. S. Brown[1], T. E. Lawrence[1], C. H. Ponce*[1], R. Pulikanti[1], C. S. Smith, Sr.[1], D. L. Mitchell[1], B. Sumerford[2], and J. D. Davenport[2], [1]*West Texas A&M University*, *Canyon*, [2]*Entex Energy*, *Amarillo, TX*.

Humate is composed of salts of humic and fulvic acids, Fe, and Al, and has reduced in vitro ammonia emissions from cattle waste at high rates of application. The objective of the present study was to evaluate the influence of a humate product (HA4, Entex Energy, Amarillo, TX) on performance, carcass merit, and tissue and serum mineral composition of beef steers. Twenty-seven crossbred steers (479 kg initial shrunk weight) were fed a 90% concentrate diet based on

steam-flaked corn containing 0, 0.5, or 1.0% of diet DM as HA4. Steers were housed in individual pens and fed treatments for 94 days before slaughter. Dietary HA4 did not affect (P > 0.10) overall DMI (8.41, 8.51, and 8.65 ± 0.3 kg/d), ADG (1.31, 1.37, and 1.36 ± 0.06 kg/d), or feed efficiency (6.45, 6.33, and 6.41 ± 0.28) for steers receiving 0, 0.5, and 1.0% HA4, respectively. Carcass marbling score, external fat thickness, LM area, and yield grade were not influenced by treatment (P > 0.10). After slaughter, bone and soft tissue samples were collected from the wholesale foreshank (IMPS 117) for mineral analysis. Sodium concentration in soft tissue was 8% greater when 1.0% HA4 was fed (P < 0.05, quadratic), whereas sulfur and zinc concentrations were increased by feeding 0.5% HA4 and returned to control values when 1.0% HA4 was fed (P < 0.05, quadratic). Bone Ca, Mg, and Na concentrations were reduced (P < 0.05, quadratic) by 0.5% HA4, but concentrations of these minerals were similar between 0 and 1.0% HA4. Aluminum was not detected in soft tissue samples, and bone Al was above the assay limit of detection (5 ppm) in only 1 or 2 animals/treatment. Serum Fe concentration on d 94 was increased by feeding 0.5% HA4 (P = 0.08; quadratic), and serum iron binding capacity on d 94 was increased by feeding either 0.5 or 1.0% HA4 (P = 0.03, quadratic; 408, 515, and 483 ± 24 ug/dL). Data suggest that HA4 may be fed up to 1% of diet dry matter for less than 100 days without an adverse impact on animal performance, carcass merit, or tissue composition.

Key Words: Humic Acid, Iron, Mineral Composition

T365 Impact of dietary K:Na:Mg ratios on the mineral utilization and rumen activity in fistulated non-lactating cows fed diets containing untreated corn silage and Silo-King®treated alfalfa haylage. G. A. Ayangbile*, D. Jones, and J. Horst, *Agri-King, Inc.*, *Fulton, IL.*

The dietary K:Na:Mg ratios influence the systemic acid base balance in dairy cows. The impact of this ratio on the rumen activity and nutrient utilization were evaluated. In a 4 × 4 latin square experimental design, non-lactating cows were fed a TMR containing a) 80% untreated corn silage:20% Silo-King® treated alfalfa haylage (80:20, CS/Hlg), b) 60:40, CS/Hlg, c) 40:60, CS/Hlg, and d) 20:80, CS/Hlg. The K concentration decreased with increased haylage, Na concentration was constant, and Cl and Mg increased as haylage increased. Cows were adapted to the diets for 16 d, followed by 5 d collection. Total DM fecal output was collected, and spot urine samples were collected at random before feeding (0 h) and after feeding (4 h). Blood and rumen fluid were obtained at 0 h and 4 h after feeding. These samples were processed, stored and later analyzed for minerals and VFA. Eletrolytes and Mg digestibilities were higher (P<.05) for the diet with the lowest K. Similar significant increases were observed for other minerals except copper. Absorption and retention of Ca, P and Mg were higher (P<.05) in diets with less K. The rumen ultracentrifuged soluble Na and P were higher for all cows at 0 h (net secretion), but lower after feeding. There was a linear decrease (P<.05) in soluble K, P, Mg, Mn, and Fe at 4 h after feeding. The total daily urine output was lower (P<.05) for cows with less dietary K. Results indicate a lower K:Na ratio and Mg adjustment in a high soluble protein type diet may help improve the mineral utilization and stabilize the mineral balance in the rumen.

Key Words: K:Na:Mg Ratios, Rumen Minerals, Treated Forage

T366 Effect of growth-rate on fat-soluble vitamin, copper and zinc concentrations in the circulation of neonatal calves. B. J. Nonnecke*[1], M. R. Foote[2], R. L. Horst[1], W. R. Waters[1], B. L. Miller[3], T. E. Johnson[3], and M. Fowler[3], [1]*National Animal Disease Center*, *Ames, IA*, [2]*Iowa State University*, *Ames*, [3]*Land O'Lakes Research Farm*, *Webster City, IA*.

Effects of three, targeted growth-rates on plasma concentrations of fat-soluble vitamins and mineral in preruminant calves were evaluated. Calves (9±2 d of age) were assigned randomly to treatments designed to achieve three targeted rates of gain [No-Growth (NG) = 0.0 kg/d, Low-Growth (LG) = 0.55 kg/d, or High-Growth (HG) = 1.2 kg/d] over an 8 wk period. Milk replacer intakes needed to achieve specified growth-rates were estimated using the NRC Nutrient Requirements of Dairy Cattle calf model computer program. All calves were fed a 30% CP, 20% fat, MR reconstituted to 14% DM. Diets were formulated to ensure that protein was not limiting. Because vitamin concentrations in the MR were based on DM intake of HG calves, NG and LG calves were supplemented with additional vitamins once weekly to compensate for reduced MR consumption. Growth rates for NG (0.11 kg/d), LG (0.58 kg/d), and HG (1.16 kg/d) calves differed throughout the study. Although vitamin A and D, and zinc concentrations were unaffected (P>.05) by growth rate, vitamin D concentrations increased (P≤0.05) and zinc concentrations decreased (P≤0.05) with time. Throughout the study these concentrations remained within normal ranges for the preruminant calf. Vitamin E and copper were affected by growth rate. At wk8, HG calves had lower (P≤0.05) vitamin E concentrations than LG and NG calves. Copper concentrations were greater (P≤0.05) for HG calves than LG and NG calves from wk4 to wk7. Vitamin E was unaffected by age (P=0.12); whereas, copper decreased (P≤0.05) with age. Concentration ranges for both variables were within ranges considered normal for neonatal calves. Results suggest that growth rate during the neonatal period may influence vitamin E and Cu availability, with vitamin E playing a pivotal role as lipid-phase antioxidant and the latter as a trace element intimately associated with a number proteins, including essential enzymes.

Key Words: Preruminant Calf, Neonatal Growth, Calf Nutrition

T367 Please see abstract # 285.

T368 Short term response of lactating cows to the supplementation of high citrus pulp content diets with corn and organic trace minerals. S. C. Salvador, M. N. Pereira*, J. F. Santos, L. Q. Melo, and M. L. Chaves, *Universidade Federal de Lavras*, *Brazil*.

Substitution of corn by citrus pulp may reduce the cost of dairy diets. However, differences in ruminal fermentation of these substrates may affect animal performance and the economic efficiency of dairy production. This experiment evaluated the response of lactating cows to the inclusion of finely ground mature flint corn to pelleted citrus pulp diets. Treatments with corn contained 10% corn and 24% citrus pulp while citrus diets contained only 33% citrus pulp as the energy concentrate. The complete substitution of inorganic sources of Cu, Mn, Se, Zn and Cr by organic sources was simultaneously evaluated. Four corn silage based diets were generated by a factorial arrangement of the two factors. Sixteen cows received the treatments in 4 4x4 Latin

squares with 21 d periods. The effect of substituting inorganic by organic mineral sources was not conclusive. Daily dry matter intake was 19.4 kg for citrus diets and 20.5 kg with corn (P=0.03). Intake of digestible organic matter was increased by corn supplementation (P<0.01). There was a trend for a decreased fractional rate of *in situ* ruminal degradation of corn silage dry matter (P=0.11) and for increased size of the indigestible fraction (P=0.15) for diets with corn, suggesting that forages degradation did not determine intake. Milk production was 27.5 kg for citrus and 28.4 kg with corn (P=0.04). Corn supplementation increased milk protein production and content (P=0.03) and had no effect on fat secretion (P>0.24). The concentration of purine derivatives in urine was numerically greater for the diets in which corn partially substituted citrus pulp. Diets formulated exclusively with citrus pulp may function when milk payment is based on volume, but some corn starch inclusion seems to be desirable when milk solids is valued.

Funded by Tortuga

Key Words: Starch, Pectin, Digestibility

T369 Effects of trace mineral sources on bioavailability and function in dairy cattle. B. J. Thering*[1], R. M. Ehrhardt[1], M. Vazquez-Anon[2], J. D. Richards[2], and T. R. Overton[1], [1]*Cornell University*, *Ithaca, NY*, [2]*Novus International*, *St. Louis, MO*.

Multiparous Holstein cows (n=30) were used to determine effects of trace mineral source on bioavailability, functional proteins, and performance. All cows were fed a basal diet formulated to meet NRC (2001) requirements for Zn (47 ppm), Cu (11 ppm), Mn (43 ppm; excess) and Se (0.27 ppm) from feedstuffs and inorganic sources beginning 3 wk prior to the experiment. Following covariate data collection, cows were assigned to one of three treatments and diets were top-dressed with either a rice hull carrier (NRC) or one of two organic trace mineral plus biotin mixtures providing 322 mg Zn, 150 mg Cu, 130 mg Mn, 3.78 mg Se, and 20 mg of biotin per day for 4 wk. One mixture was MINTREX® organic trace minerals (Mintrex) and the other (AA-complex) was Met and Lys complexes of trace minerals, Se-yeast, and biotin. Liver Cu concentrations tended to be increased for cows fed Mintrex and AA-complex compared to NRC following 4 wk (481, 539, 562 ppm; P<0.10) and overall liver Se concentrations tended to be increased by Mintrex and AA-complex compared to NRC (1.49, 1.89, 2.09 ppm; P<0.10), but overall liver Mn and Zn were not affected by treatment. Metallothionein mRNA in liver was increased at wk 1 for cows fed Mintrex (P<0.05) and unchanged in cows fed AA-complex or NRC. Cows fed Mintrex had higher milk Mn during wk 4 compared to NRC (17.6, 24.0, 20.1 ug/kg; P<0.04). Whole-blood Se was increased in cows fed Mintrex compared to NRC (19.9, 21.4, 21.1 µg/dL P<0.05). Treatment did not affect plasma and liver superoxide dismutase and glutathione peroxidase. Milk yield and DMI were not affected by treatment, but cows fed Mintrex had increased (P<0.05) milk fat (3.48, 3.81, 3.51%), true protein (3.12, 3.20, 3.14%), and total solids (12.1, 12.5, 12.2%). Overall, supplementation with both forms of organic trace minerals resulted in increased bioavailability, but Mintrex supplementation further increased liver MT expression and milk component content compared to either the control or AA-complex treatments.

Key Words: Trace Mineral, Bioavailability, Dairy Cow

T370 Milk yield and reproductive performance in Holstein cows supplemented with Chromium in early lactation. B. Lavín-Garza[1], A. Garza[2], M. Daccarett[3], F. R. Valdez[4], C. A. Meza-Herrera[5], and R. Rodríguez-Martínez*[6], [1]*Beta Santa Mónica*, *San Pedro, Coahuila, México*, [2]*Beta San Gabriel*, *Francisco I. Madero, Coahuila, México*, [3]*Private Consultor*, *Madera, CA*, [4]*Kemin Agri. Food Norteamerica Inc.*, *Des Moins, IA*, [5]*Unidad Regional Universitaria de Zonas Áridas-Universidad Autónoma Chapingo*, *Bermejillo, Dgo., México*, [6]*Universidad Autónoma Agraria Antonio Narro Unidad Laguna*, *Torreón, Coah., México*.

Chromium is an essential mineral in diets for humans and laboratory animals because it is an active component of the Glucose Tolerance Factor and its effect on milk yield and reproductive performance in cows has been reported, both in multiparous as well as on primiparous cows. However, reports regarding its function are contradictories denoting a better milk yield and reproductive performance in primiparous than multiparous cows. The aim of this study was to evaluate Cr supplementation upon milk yield and reproductive performance during early lactation in dairy cows. The study was carried out in Northern Mexico (25° NL, 102° WL, 1,100 m). A total of 147 cows were assigned to four groups: 1) PCr, (n=36, primiparous cows) and 2) MCr (n=39, multiparous cows), both supplemented with 10 mg Chromium essential base (KemTRACE Cr 0.04% Kemin Industries, Des Moines, Iowa, USA) mixed in the total mixed ration, and 3) PnCr, (n=38) and 4) MnCr, (n=34), primiparous and multiparous cows, respectively, both without Cr supplementation. Response variables considered total milk yield per cow per day (TMY), peak milk yield (PMY), days to peak milk yield (DPMY), days at first IA (DIA), and number of services per conception (SPC). Variables were recorded and analyzed by the Proc GLM of SAS. No Differences (P>0.05) in PMY between PCr AND PnCr occurred (41.0 vs 40.3 l), but MCr-cows had higher (P<0.01) PMY than MnCr (62.9 d vs 57.6 d). A decreased (P<0.01) DPMY was observed in PCr-cows with respect to PnCr-cows (70.6 d vs 100.7 d), but were similar (P>0.05) in both primiparous groups. TMY and DIA were similar (P>0.05) in both supplemented and non-supplemented primiparous and multiparous cows. SPC was lower (P<0.01) in PCr with respect to PnCr (1.6 vs 2.4), while differences between MCr and MnCr groups did not occurred. These results support the importance of Cr supplementation in dairy cows, upon milk yield and reproductive performance, especially in primiparous cows managed under intensive conditions.

Key Words: Chromium, Milk Yield, Reproductive Performance

T371 Blood mineral, hormone, and osteocalcin responses of multiparous Jersey cows to an oral dose of 25-hydroxyvitamin D_3 prior to parturition. M. S. Taylor*, K. F. Knowlton, M. L. McGilliard, and J. H. Herbein, *Virginia Polytechnic Institute and State University*, *Blacksburg*.

Increasing blood calcium (Ca) prior to parturition could attenuate the severity of periparturient hypocalcemia. Jersey cows tend to be susceptible to peripartutient hypocalcemia, therefore our objective was to evaluate the effects of a prepartum oral dose of vitamin D_3 (D_3) or 25-hydroxyvitamin D_3 (25-OH) on factors associated with peripartum blood Ca regulation in Jersey cows. Twenty-seven multiparous Jersey cows were randomly assigned to receive an oral bolus containing corn starch (control) or corn starch plus 15 mg of 25-OH or 15 mg of D_3 at 6 d prior to expected parturition. Cows were maintained in individual

box stalls from 20 d prior to parturition and fed a common diet. Jugular blood samples were collected at -14, -13, -5, -4, -3, -2, -1, calving, 1, 3, 5, 7, 9, 11, 13, 28, 56, and 84 d. After calving cows were housed in a free-stall barn and consumed a common diet. Colorimetric assays were used to analyze Ca, P, and Mg concentrations in serum. Osteocalcin (OC), an indicator of bone formation, was determined using a competitive immunoassay. Serum 25-hydroxyvitamin D_3 and parathyroid hormone (PTH) were determined only in samples obtained from -5 through 13 d. Blood Ca, P, and Mg decreased around the time of calving and then increased over time. Serum OC was higher in second lactation cows compared with cows entering their third or fourth lactation. Serum 25-hydroxyvitamin D_3 was higher for cows dosed with 25-OH (119.0 pg/ml) compared with those dosed with D_3 (77.5 pg/ml) or control (69.3 pg/ml). Cows dosed with 25-OH tended to have lower serum PTH concentration, but treatments did not affect serum Ca, P, or Mg. Although results indicated a 60% increase in serum 25-hydroxyvitamin D_3 due to a single oral dose of 25-OH prior to calving, the amount administered in this study apparently was not sufficient for initiation of any improvement in Ca homeostasis at parturition.

Key Words: Calcium, Osteocalcin, Cow

T372 Changes in phosphorus metabolism of ruminants fed with different cation anion balances and proportions of roughage and concentrate. M. S. V. Salles[1], M. A. Zanetti[2], T. M. Ribeiro[2], and S. F. M. Bonilha*[1], [1]*Agência Paulista de Tecnologia dos Agronegócios*, *Assis, São Paulo, Brazil*, [2]*Faculdade de Zootecnia e Engenharia de Alimentos - USP*, *Pirassununga, São Paulo, Brazil*.

There is an increasing environmental concern about P excretion from feedlot cattle to the environment. As dietary cation anion balance (DCAB) may change mineral retention, research leading to appropriate DCAB can help minimize such impact. Thus, two experiments were carried out in the FZEA/USP (Brazil) aiming to access DCAB effect in diets with different proportions of roughage and concentrate on the phosphorus metabolism of young ruminants. On each experiment, 24 Holstein calves (91.43 ± 12.44 Kg of average BW for the first and 117.62 ± 20.88 for the second experiment) were randomly allotted to individual cages and fed during 35 days the following treatments: DCAB of -123, +218 and +341 mEq/kg of DM, in a diet of 60% of roughage (corn silage) and 40% of concentrate (60R40C) in the first experiment and DCAB of -127, +207 e +397 mEq/kg of DM in a diet of 40% of roughage and 60% of concentrate (40R60C) in the second experiment. Ionic coefficients were achieved through addition of ammonium sulphate or sodium bicarbonate. Balance of P was determined by total feces and urine collection during five days. All P determinations were carried out through a colorimetric method (725 nm reading). Data were analyzed in a completely randomized design using PROC GLM of SAS. Orthogonal polynomial contrasts were used to partition treatment effects, and adopted the significance level of P<0.10. Results are presented on table 1. The higher P retention occurred in DCAB +341 with diet 60R40C and in DCAB +207 in diet with 40R60C; however, the diet that excreted less P was with DCAB +341 with diet 60R40C (5.68 g/day).

Table 1. Phosphorus balance in calves

Item	60R40C -123	+218	+341	SEM	Linear	Probability Quadratic
P intake (g/day)	7.97*	9.99	11.97	0.48	0.0003	0.6268
P retention (g/day)	3.64	4.31	6.87	0.38	0.0001	0.0282
P retention/ P intake (%)	45.42	43.39	56.79	1.82	0.0071	0.0062
Item	**40R60C -127**	**+207**	**+397**	**SEM**	**Linear**	**Quadratic**
P intake (g/day)	12.92	21.26	20.37	1.22	0.0017	0.0758
P retention (g/day)	7.49	13.64	12.75	0.91	0.0037	0.0714
P retention/ P intake (%)	52.67	63.88	62.26	2.46	0.0769	0.2952

*mean values

Key Words: DCAB, Mineral, Retention

T373 Please see abstract # 284.

T374 Cobalt/vitamin B_{12} status of embryo donor ewes, but not recipients, affects neonatal lamb behavior. C. M. Dwyer*, C. J. Ashworth, J. J. Robinson, J. A. Rooke, T. G. McEvoy, and L. M. Mitchell, *SAC*, *Edinburgh, UK*.

Earlier reports indicate that lambs born to ewes sub-clinically deficient in cobalt/vitamin B_{12} during pregnancy are slow to stand and suck and have increased morbidity and mortality. These problems are not prevented by cobalt supplementation during mid to late pregnancy, suggesting that they originate during early development. The aim of this study was to distinguish between the effects of cobalt/vitamin B_{12} status of ova and of the recipient ewe on lamb behavior using reciprocal embryo transfer. Ewes from cobalt-deficient farms were either untreated (-Co, n=82) or were given an intra-ruminal cobalt-containing bolus 30 days before embryo transfer (+Co, n=82). Day 6 embryos were recovered from 33 superovulated -Co or +Co ewes and transferred singly to -Co or +Co recipient ewes. Lamb behavior (n=48 lambs) was recorded by focal observation at birth and during the first 3 days of life by scan sampling at 2-hourly intervals. Data were analysed by linear mixed models using natural log transformations of behavior data that were not normally distributed. Circulating concentrations of vitamin B_{12} on the day of ovum recovery were higher in +Co than -Co donors (P<0.001). Concentrations of vitamin B_{12} were lower in -Co compared to +Co ewes during pregnancy (P<0.001) and in lambs born to -Co compared to +Co ewes at birth (-Co=543 pmol/l, +Co=1805 pmol/l s.e.d.=92.1, P<0.001). There was no effect of donor or recipient cobalt/vitamin B_{12} status on lamb birth weight, on lamb behavior immediately after birth, on mean ewe-lamb distance during the first 3 days of life, or on any aspect of ewe behavior. However, lambs from +Co donors were more active than lambs from -Co donors; they stood more frequently (% observations active: +Co donor=29.6, -Co donor=22.0, s.e.d.=2.4, P<0.01), were more frequently observed interacting with their mother (% observations: +Co donor=6.3, -Co donor=3.1, s.e.d.=1.2, P<0.01) and spent more time exploring their

environment (% observations: +Co donor=16.6, -Co donor=6.9, s.e.d.=2.3, P<0.001). These data indicate that nutrient status prior to mating and during the early cleavage stages of embryo development affects lamb behavior.

Key Words: Sheep, Behavior, Vitamin B_{12}

T375 Effects of maternal nutrition and selenium supply on visceral organ mass of pregnant ewe lambs. J. J. Reed*[1], T. L. Neville[1], K. A. Vonnahme[1], P. P. Borowicz[1], J. B. Taylor[2], D. A. Redmer[1], J. S. Luther[1], C. J. Hammer[1], L. P. Reynolds[1], and J. S. Caton[1], [1]*Center for Nutrition and Pregnancy, Animal and Range Science Department, North Dakota State University*, *Fargo*, [2]*USDA-ARS, U. S. Sheep Experiment Station*, *Dubois, ID*.

To examine effects of maternal nutrient restriction or excess and dietary Se on maternal visceral organ mass, 82 pregnant Rambouillet ewe lambs (52.2 ± 0.8 kg) were allotted randomly to one of 6 treatments in a 3 x 2 factorial design. Groups included plane of nutrition (60% [RES], 100% [CON], and 140% [HIGH] of requirements) and dietary levels of Se (adequate Se [7.4 µg/kg BW] vs. high Se [85 µg/kg BW]; from Se enriched yeast). Selenium treatments were initiated at breeding and nutritional treatments on d 40 of gestation. All diets were fed once daily in a complete pelleted form (36.5% beet pulp, 22.3% alfalfa meal, 16.2% corn, 18% soybean hulls, and 7.0% soybean meal; 14.4 % CP, 2.63 Mcal ME/kg; DM basis). Within 24 h after parturition, ewes were necropsied and tissues harvested. Empty maternal BW was least ($P < 0.01$) in RES, intermediate in CON, and greatest in HIGH. Selenium supplementation did not alter empty maternal BW. Mass (g) of the rumen, reticulum, omasum, abomasum, liver, pancreas, spleen, omental fat, kidney, and perirenal fat were least ($P < 0.01$) in RES, intermediate in CON, and greatest in HIGH ewes. When expressed as g/kg of empty BW, the responses to treatment differed; for example, for abomasum, jejunum, and large intestine, RES had greatest ($P < 0.01$), CON intermediate, and HIGH the least. Supplemental Se increased ($P < 0.10$) ruminal, abomasal, and small intestinal mass (g/kg empty BW) compared with adequate Se. No other differences in visceral organ mass were observed in response to Se supplementation. These data indicate that maternal nutrition has large impacts on visceral organ mass and that Se supplementation at supranutritional levels alters the mass of some gastrointestinal organs in pregnant ewe lambs.

Key Words: Maternal Nutrition, Selenium, Visceral Organ Mass

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SYMPOSIA AND ORAL SESSIONS

Animal Behavior & Well-Being - Livestock and Poultry II

377 Cross ventilation in commercial livestock trailers shows promise for improving comfort, reducing weight loss and reducing environmental contaminants. T. H. Friend*, N. M. Giguere, and P. D. Krawczel, *Texas A&M University*, *College Station*.

A practical method of creating cross ventilation in commercial livestock trailers is being developed and evaluated. An initial series of trials determined traveling at highway speeds generated winds only ranging from 1 to 5.6 kmph in the commercial livestock trailers. Subsequent trails found that simulated environmental contaminates (smoke) could be cleared six times faster from a 5.2 × 2.4 m compartment of a semi trailer traveling 89 kmph using cross ventilation created by three externally mounted 12.5 × 10 cm (W × D) intake scoops facing forward, and another set of three exhaust scoops mounted on the opposite side of the trailer facing back. The efficacy of creating cross ventilation in the zone between the deck and the bodies of cattle was then investigated in two cool-weather trials, each with a ventilated and a control trailer transporting 80 calves to the same destination. Calves averaged 275 kg, came from the same source, and transport averaged 11.5 h in duration. Fifty-three 14 × 14 × 7 cm (L × W × D) scoops were mounted on the lowest set of two punches (25 cm above deck) on alternate panels (80 cm intervals) of every compartment in the ventilated trailer. The scoops on one side of the trailer were set as intakes while those on the opposite side were oriented to exhaust air. Temperature within the cross-ventilated trailer ranged from 0 to 4°C lower than in the control trailer, with the differential highly dependent on the speed and direction of prevailing winds. Ammonia concentrations averaged 35.5% lower in the ventilated trailer. Calves in the ventilated trailer had an average weight loss of 4.7% while calves in the control trailer lost 5.8%. Sodium concentrations were elevated ($P > 0.05$) in the non-ventilated calves 8.5 h post transport indicating greater dehydration in the non-ventilated calves. Creating cross ventilation through the use of external air scoops has the potential to improve the well-being and health of livestock, and merits further research.

Key Words: Transportation, Ventilation, Cattle

378 Genetic basis of different effects of chronic intermittent social stress on immune function and survivability in laying hens. A. G. Fahey*[1,2], R. M. Marchant-Forde[2], and H. W. Cheng[2], [1]*Purdue University*, *West Lafayette, IN*, [2]*USDA-ARS*, *West Lafayette, IN*.

Chronic social stress has a large impact on animals' susceptibility to disease. This study was designed to examine the effects of genetic selection and genotype-by-environmental interactions on chicken immune parameters and longevity. Chickens from HGPS (selected for high production and survivability, also called KGB, kind gentle birds previously) and DXL (Dekalb XL, a commercial strain) were used in this study. Chickens were housed in 8 bird cages (213 cm^2/bird) from 34 - 45 wks of age. During the test period, two birds were moved between cages within the same genetic line to create a social instability called chronic intermittent social (CIS) stress. At 45 wks of age, blood samples were collected from the bronchial vein within two minutes after removing the chickens from their cages for immunological and corticosterone analysis from ten cages per line. Following euthanasia, body weight and several organ weights were measured. Results showed that DXL hens had a heavier adrenal weight (both absolute and relative weight) ($P<0.05$) than HGPS hens, while there were no differences in the body weight and weights of the spleens and livers between DXL and HGPS hens ($P>0.05$). Compared to the HGPS hens, DXL hens also had a higher portion of $CD8^+$ cells ($P<0.01$), resulting in a lower $CD4^+$:$CD8^+$ ratio ($P<0.05$). There were no significant differences for plasma concentrations of corticosterone between the hens from DXL and HGPS lines ($P>0.05$). Results also showed that DXL hens had a higher mortality than HGPS hens ($P<0.01$). The data suggests that, compared to HGPS hens, chronic intermittent social stress may adversely affect the immune function and survivability of DXL hens. The results indicate that, similar to other animals, there are heritable components in chickens' disease resistance and stress response, which is regulated differently by genotype-by-environment interactions.

Key Words: Stress, Hens, Immune

379 Different effects of individual identification systems on chicken well-being. R. L. Dennis*[1,2], A. G. Fahey[1,2], and H. W. Cheng[1], [1]*Livestock Behavior Research Unit, USDA-ARS*, *West Lafayette, IN*, [2]*Purdue University*, *West Lafayette*.

Individual identification is a common method used in animal research. This study was designed to examine if various common identification systems, i.e., leg bands (LB), wing bands (WB), neck tags (ST), and livestock marker (LM), have different effects on hens' behavioral and physiological homeostasis. At 18 wk of age, hens were paired in all combinations of treatments and control (C, unmarked hens; n=10) in a novel cage for 5 trials of 1 hr each to test the effects of markers on social behaviors. Increased feather pecking (FP) was exhibited in WB hens compared with C hens ($P<0.10$) but not in LB, ST or LM hens ($P>0.10$). Increased FP in hens with WB may suggest an increase

in social stress and may lead to increased feather and body damage. No effect of identification treatment was evident on frequency of aggressive behaviors (P>0.10). At 20 wk of age, absolute fluctuating asymmetry (FA), but not relative FA, of shank length and width was more significant in LB hens (P<0.05), and tended to be significant in WB (P<0.10), but not in ST or LM hens, compared to C hens. Asymmetry of the shank is often a result of high stress levels, including social stress. Body weight (BW) measures at 20 wk showed hens with LB, but not WB, ST or LM, were significantly lighter than C hens (P<0.05), possibly as a result of decreased access to resources, increased metabolism or decreased appetite due to elevated stress. Increased FA and decreased BW are evidence of a disruption of the hens' physiological homeostasis due to increased stress. Leg banded hens also tended to have lower percent heterophil (P<0.10), indicative of increased stress and reduced immunocompetence. Our findings provide clear evidence of the negative effects of WB and LB systems on hens' well-being, altering both physiological and behavioral homeostasis, possibly leading to misinterpretation of experimental results.

Key Words: Identification System, Feather Pecking, Hen

380 The relationship between residual feed intake and feeding behavior in growing heifers. G. M. Bingham*, T. H. Friend, G. E. Carstens, and P. A. Lancaster, *Texas A&M University*, *College Station*.

The objective of this study was to determine if feeding behavior is correlated with feed efficiency traits in growing heifers. Individual dry matter intake (DMI) was measured in Brangus heifers (n = 115) fed a roughage-based diet (ME = 2.1 Mcal/kg) for 70 d using Calan gate feeders (6 heifers/pen). Residual feed intake (RFI) was computed as the residuals from linear regression of DMI on mid-test $BW^{0.75}$ and average daily gain (ADG), and heifers with the highest (n = 18) and lowest (n = 18) RFI were identified for feeding behavior measurements. During wk 5 through 8 of the 70-d feeding trial, continuous video recordings were obtained for all heifers. Video images for 2 sets of 4 24-h periods, 2 wk apart, were analyzed for the selected animals. All occurrences of feeding were timed and counted per day, and the 8 24-h periods averaged to derive mean head-down duration and meal frequency per heifer. Head-down duration (HD) was defined as the total min per day the animal's head was down in the feed bunk. A meal was defined as to include all visits an animal made to the feed bunk that were separated by less than 5 min. The resulting data were compared between the 2 groups analyzed using one-way ANOVA. Average RFI scores for low and high RFI heifers were -1.03 and 1.00 ± 0.33 kg/d. Low RFI heifers consumed 22.5% less (P < 0.001) DMI, but had similar BW and ADG compared to high RFI heifers. Heifers with low RFI spent more time (P < .05) eating (152 vs 124 ± 10 min/d), but had similar meal frequencies (14.78 vs 15.11 ± 0.54 meals/d) compared to high RFI heifers. Pearson correlation coefficients were used to determine the relationship between RFI and HD and meal frequency. There was a negative correlation (r = -0.39, P < 0.05) between RFI and HD, but meal frequency was not correlated with RFI (r = 0.05). These data suggest that RFI is moderately correlated to HD but not meal frequency in growing calves.

Key Words: Residual Feed Intake, Feeding Behavior, Cattle

381 The effect of the autosort system on swine behavior. A. E. DeDecker*, J. M. Suchomel, and J. L. Salak-Johnson, *University of Illinois*, *Urbana*.

Limited data exist on the impact that autosort, a relatively new, behavior-based production system has on pig well-being. The objective of this study was to examine the effect various autosort floor layouts have on the behavior and well-being of wean-to-finish pigs. At weaning, 622 ± 13 pigs were randomly assigned to a water pen (WP; 20% floor space), food court (FC; 40% floor space), or fast lane (FL; 12.5% floor space per zone) autosort layout, or conventional large pen (CV). Behavior data was collected by live observations during a 3-week training period and at loading. Continuous video-records were used for scan sampling to determine the total number of animals performing a specific behavior at a specific time. Specific behaviors for loading and training were observed and recorded. Data were analyzed using Chi-Square and a MIXED procedure of SAS with repeated measures. During training the WC pigs went in and out of the scale at a faster rate than did FC or FL pigs (P≤0.05). The FC pigs spent more time (P=0.02) engaged in aggressive encounters than did pigs in the FL. The FL pigs hesitated more (P=0.03) upon entering the scale than did pigs in the WC, whereas the FC pigs hesitated more (P = 0.03) upon entering the scale compared with the FL pigs. The time spent eating or drinking and the number animals engaged in these behaviors at one time was significantly affected by treatment. For example, time spent eating among 1-5 pigs was greater (P≤0.05) for the CV pigs than for the FC, WC, or FL pigs, whereas time spent eating among >10 pigs was greater (P<0.0001) in FC layout than in the CV pens. Vocalization and prod use was greater (P≤0.01) among CV pigs compared to WC, FC, or FL at loading. FC had a greater number of lame animals when being removed from the pen than did CV (P=0.01). The number of rears at loading were greater (P<0.001) for CV pigs than WC pigs. The CV pigs had greater difficulty loading onto the truck than did pigs from FL (P=.05) and WC (P=0.02). These data indicate that autosort layouts can affect various behaviors, ease of handling, and loading throughout the wean-to-finish phase, thus using behavior to optimize these layouts is important.

Key Words: Autosort, Behavior, Well-being

382 Movements of translocated desert mule deer in Sierra del Carmen, Coahuila, Mexico. J. L. Martinez* and L. A. Harveson, *Sul Ross State University*, *Alpine, TX*.

Population of desert mule deer (Odocoileus hemionus crooki) have shown declines in the past, to an extent where for several decades they were considered to be in danger of extripation. The goal of this research is to restore population density of desert mule deer to the Sierra Maderas del Carmen of Mexico. Near 200 mule deer will be captured using net-guns and helicopter and transported to Sierra del Carmen. 40 to 50 deer will be randomly selected for our study and mortality sensitive radio-transmitters will be affixed to each mule deer, they will be monitored 3 to 5 times a week. Movements will be monitor to survey site fidelity and post release movements. Home range and movement rate comparisons will be made between seasons, sexes, and age classes. We are expecting 75% of the sample size to remain (site fidelity) within 15 kilometers from the release site. Mortality of radio-collared desert mule deer will be determined by mortality-sensitive transmitters, each mortality will be recorded and investigated. Habitat maps will be generated from black and white

and color infrared photographs or from concurrent SRSU research projects. Vegetation composition will be collected from transects. Species composition, canopy coverage, and other physical attributes will be used to describe habitats. Habitat preference will be determined using habitat selection ratios. Results from habitat analysis will identify key habitats relative to forage production, escape cover, and fawning habitat. The results of this study will aid future restoration efforts for desert mule deer. By the end of the study there will be a geographical representation of the habitats for mule deer of the Sierra del Carmen that will allow resource managers and landowners to establish realistic population objectives to minimize predator-specific mortalities, plus knowledge in the identification of crucial habitat for fawning, forage and escape habitat. Finally, this study will generate a management guideline for desert mule deer in Northern Mexico.

Key Words: Mule Deer, Site Fidelity, Maderas del Carmen

383 Exercise increases bone density in the joints and limbs of gestating stall-housed gilts. E. L. Schenck*[1], K. A. McMunn[2], D. Rosenstein[3], B. D. Nielsen[3], B. T. Richert[1], J. N. Marchant Forde[2], and D. C. Lay Jr.[2], [1]*Purdue University*, *West Lafayette, IN*, [2]*USDA-ARS-MWA*, *West Lafayette, IN*, [3]*Michigan State University*, *East Lansing*.

Lameness in breeding age gilts and sows is a major cause of early culling, causing increased economic loses and welfare concerns. Stall-housed sows tend to have more joint, foot and leg problems than group-housed sows. The aim of this study was to determine if exercise would decrease lameness, increase bone density, and increase muscle mass of gilts that were exercised versus not exercised during gestation. The study was composed of three treatment groups; control (C, n=8, no exercise), high exercise (H, n=5, 121.9 m 2 d/wk and 426.7 m for 3 d/wk) and low exercise (L, n=5, 121.9 m 5 d/ wk). All gilts were stall-housed for the duration of gestation and H and L gilts were exercised from d 35 to 110 of gestation. Blood was taken on d -14, 35, 56, and 110 of gestation and at the end of lactation via jugular veni-puncture and collected serum was analyzed for osteocalcin by an enzyme immunoassay (EIA). At the end of lactation, sows were sacrificed and the left fore- and hind limbs were harvested. Specific muscles and bones from the fore and hind limbs were dissected out, weighed, and removed. Hooves were scored based on number and severity of lesions, cracks, and bruises. The patella and calcaneous bone density was determined by dual energy x-ray (DEX) scans. All other bone mineral density was determined by computed tomography (CT). Osteocalcin concentration in the L group was greater ($P<0.05$) than C at d 35 and 56 and tended to be greater ($P<0.1$) at d 110. There was no difference in hoof scores, muscle/body weight ratio, or in bone mineral density of the patella or calcaneous. Bone density (mg/cm3) was greater ($P<0.05$) in the femur and the humerus of the L group compared to that of the C group and tended ($P<0.1$) to be higher in the femur compared to the H group. The bone density of the radius of the H group was greater ($P<0.05$) than both L and C groups. Scapular and proximal humerus articular cartilage scores of the L group were greater ($P<0.05$) than both H and C groups. Exercise appears to increase bone density, however the relationship with exercise amount and intensity is not clear at this point.

Key Words: Swine, Lameness, Bone Strength

384 Effects of pre-weaning strategies on blood metabolites, behavior, and performance of beef calves. H. T. Boland*[1], G. Scaglia[1], W. S. Swecker, Jr.[2], and N. C. Burke[2], [1]*Virginia Polytechnic Institute and State University*, *Blacksburg*, [2]*Virginia-Maryland Regional College of Veterinary Medicine*, *Blacksburg*.

Traditionally, beef calves are abruptly weaned from their dams at 6 to 8 mo of age. Alternate weaning strategies have been suggested to reduce stress and improve performance of post-weaned calves. Two alternate weaning strategies were compared to abrupt weaning over a 2 yr period in spring-born, Angus-cross steers (yr 1, n=48; yr 2, n=54). Steers (IBW: yr 1=241 ± 5 kg, yr 2=242 ± 3 kg) were allotted to three treatments 7 d before weaning: fence-line (FL, separated from dam by a fence), nose clips (NC, placement of anti-suckling device and remained with dam), or control (CTRL, remained with dam and abruptly separated on d 0). On d 0, all steers were transported (170 km) away from their dams, held in a dry-lot with hay and water overnight, and placed in pastures on d 1. Steers were maintained in their pre-weaning treatment groups for a 42 d backgrounding period. Blood was collected by jugular venipuncture on d -7, 0, 1, 7, and 42. Serum was analyzed for NEFA, blood urea nitrogen (BUN), creatine kinase (CK), and glucose. Pedometers recorded steps/d for 7 d pre-weaning and 6 d post-weaning. Average daily gain was calculated from weights on d -7, 0, 1, 14, 28, and 42. Data were analyzed using PROC MIXED with Tukey's adjustment for means separation. Year was the repeated measure and paddock was the experimental unit. Model included year, day, treatment, and treatment x day interaction. There was a year effect for NEFA, BUN, and glucose ($P<0.05$). Within CTRL and NC treatments, CK was highest ($P<0.05$) on d 1, while FL steers had similar levels of CK on d -7 and 1. On d 0, NC steers had higher NEFA concentrations ($P<0.05$) than FL or CTRL steers. Fence-line steers took more ($P<0.05$) steps than NC steers on d -7 and -6. Over the 7 d pre-weaning period, NC calves took the least ($P<0.05$) number of steps. Post-weaning, CTRL steers took more ($P<0.05$) steps overall than FL or NC, due to more steps/d taken on d 1 and 6. Overall, ADG was lowest ($P<0.05$) for NC calves. The use of nose-clips in this study did not seem to benefit calves while FL management may be less stressful than abrupt weaning.

Key Words: Stress, Weaning, Behavior

385 Effect of stocking density on cow comfort indices. P. D. Krawczel*[1,2], H. M. Dann[1], C. S. Ballard[1], and R. J. Grant[1], [1]*W.H. Miner Agricultural Research Institute*, *Chazy, NY*, [2]*The University of Vermont*, *Burlington*.

The objective of this study was to evaluate the effect of stocking density (100, 113, 131, and 142%) on cow comfort index (CCI; # of cows lying in stalls (# of cows lying or standing within a stall)$^{-1}$) × 100), stall standing index (SSI; # of cows standing in stalls (# of cows lying or standing within a stall)$^{-1}$) × 100), and stall use index (SUI; # of cows lying in stalls (total # cows - # of cows eating)$^{-1}$) × 100) during a 24-h period, a 4-h peak lying period (0000 to 0400), and a 1-h period after milking. Holstein cows (n = 136) were assigned to 4 pens within a freestall barn in a 4 × 4 Latin square design. At 100% stocking density, a stall and headlock was provided for each cow and the greater densities were simulated by denying access to stalls and headlocks. Indices were calculated from video data recorded continuously for 2 d after 5 d of acclimation to each stocking density and analyzed with 10-min scan samples for the percentage of cows

lying in stalls, standing in stalls, standing in alleys, and feeding. During the 24-h period, treatment tended ($P = 0.07$) to affect CCI and SSI; however, SUI decreased at higher stocking densities ($P = 0.02$). Treatment effects were observed in CCI, SSI, and SUI between 0000 and 0400 ($P < 0.05$). Treatment did not affect indices during the 1 h after milking ($P > 0.1$). The increased percentage of cows standing in alleys at higher stocking densities ($P < 0.001$) indicated reduced comfort, which was only incorporated into SUI. These results indicated that increased stocking densities affected cow comfort indices; SUI more accurately reflected cow comfort on a pen level at higher stocking densities; and measuring SUI during peak lying was recommended for an accurate assessment of comfort on a pen level.

Table 1. Differences in CCI, SSI, SUI, and standing behavior at each stocking density during a 24-h period and between 0000 and 0400

Time	Variable	100%	113%	131%	142%	SE
24 h	CCI, %	80.7	81.9	82.9	82.6	1.1
	SSI, %	19.3	18.1	17.0	17.3	1.1
	SUI, %	70.1^{a}	70.2^{a}	68.6^{ab}	66.3^{b}	1.2
	Standing, %	10.9^{c}	12.0^{c}	14.4^{b}	16.5^{a}	1.2
0000 to 0400	CCI, %	85.4^{ab}	86.7^{a}	86.3^{ab}	84.5^{b}	1.2
	SSI, %	14.6^{ab}	13.3^{b}	13.7^{ab}	15.6^{a}	1.2
	SUI, %	80.3^{a}	79.5^{a}	74.8^{b}	69.6^{c}	1.4
	Standing, %	5.3^{d}	7.4^{c}	11.6^{b}	15.3^{a}	0.5

^{abcd}Values in each column without a common superscript differ ($P \leq 0.05$)

Key Words: Cow Comfort, Stocking Density, Behavior

386 Space requirements of weaned pigs during transportation. M. A. Sutherland*, N. Krebs, L. E. Hulbert, J. S. Smith, and J. J. McGlone, *Texas Tech University*, *Lubbock*.

The space allowances provided to weaned pigs are based on professional experiences of producers. The objective of this research was to establish a first estimate of the space requirements of weaned pigs based on measures of animal well-being. A commercial semi-trailer was fit with compartments that provided 0.05, 0.06 and 0.07 square meters per pig (5.2 ± 0.10 kg) with a constant 100 pigs per compartment on both the upper and lower decks. The trailer was fit with HOBOs to record temperature, humidity and wind speed. Cameras were placed in each experimental compartment to record behavior of the pigs during transport. Prior to transport, blood samples were taken from 4 pigs per compartment for physiology and immune measures and weights and lesion scores were recorded. Pigs were then transported for 2 h to the wean-to-finishing site using the same route for each replication. At the finishing site, blood samples were taken from experimental pigs for physiological and immunological measures, weights, and lesion scores. This experiment was replicated 4 times during winter. Temperature and humidity within the compartments were effected by an interaction between space allowance and deck ($P < 0.001$). Cortisol, neutrophil to lymphocyte ratio and lesion scores were increased ($P < 0.001$) during transport regardless of space allowance, deck or gender. Different space allowances during transport did not influence any performance or physiological measures measured in this study. Increased cortisol concentrations and neutrophil to lymphocyte ratio in transported weaned pigs suggests that these pigs experienced stress, however space allowances within the range of spaces tested did not appear to influence this response. In winter, space allowances of 0.05, 0.06 and 0.07 square meters per pig do not influence pig well-being as measured by body weight changes and physiological measures.

Key Words: Transport, Pigs, Animal Welfare

387 Behavior of beef calves weaned by traditional, fenceline and two-step methods. J. M. Siegford*, D. D. Buskirk, and M. K. Sharra, *Michigan State University*, *East Lansing*.

Traditional abrupt weaning of beef calves causes behavioral, physiological, and immunological stresses in calves which may persist for days to weeks. Non-abrupt weaning methods, such as fenceline and two-step weaning, may reduce weaning stress by simulating the natural weaning process by providing calves with maternal contact while nursing is prevented. The effects of three weaning methods on the behavior of calves were compared using direct observations and pedometers equipped with accelerometers and inclinometers. Over two years, 224 Angus-Simmental calves were evenly allocated by weight and sex into three treatments: 1) abrupt-weaned (AW); 2) fenceline-weaned (FW); and 3) two-step-weaned (TW). On day 0 (d 0) calves were prevented from nursing by removing AW dams to remote pastures, placing FW dams and calves across a fence, and fitting TW calves with a plastic nose flap. On d 5, TW and FW dams were moved to remote pastures. Instantaneous observations of behavior were performed each year on 10 calves per treatment every 20 minutes from 0900-1200 and 1400-1700 on d 1 and 6 after weaning. Pedometers recorded activity, standing, lying and number of steps from d 0-10. On d 1, AW calves stepped more, were observed walking more, and were more active ($P<0.01$) than FW and TW calves. On d 1, FW calves stepped more and were observed walking more ($P<0.01$) and were more active ($P<0.05$) than on subsequent days. On d 1, AW and FW calves grazed less than TW calves ($P<0.01$). AW calves vocalized more than TW ($P<0.01$) but not FW calves on d 1. More standing was observed on d 1 than on d 6 ($P<0.05$) but was not recorded by pedometers. Pedometers recorded less lying by AW on d 1 compared to lying by AW on other days. Data from observation and pedometers yielded similar results for active behaviors. However, results differed for standing and lying, likely because pedometers recorded over 24 h while observations were done during the day. Removal of dams on d 5 did not significantly affect behavior of FW and TW calves. Non-abrupt weaning appears less behaviorally stressful on calves.

Key Words: Calf, Stress, Pedometer

388 Prediction of degree of mastitis from repeated measurements of lactate dehydrogenase (LDH) in milk. N. C. Friggens*[1], M. G. G. Chagunda[1], M. Bjerring[1], C. Ridder[2], S. Højsgaard[1], and T. Larsen[1], [1]*University of Aarhus, Faculty of Agricultural Sciences*, *Denmark*, [2]*Lattec I/S*, *Hillerød, Denmark*.

This study aimed to test a model for mastitis detection using a logic that allows examination of time-related changes and a progressive scale of mastitis state (i.e. not using specificity/sensitivity). The model (Chagunda et al., 2006, J. Dairy Sci. 89:2980) produces a Mastitis Risk for each cow, on a scale 0 (completely healthy) to 1 (full blown mastitis). The main input is LDH (µmol/min/l) x milk yield. A test set containing 602 lactations and 849 mastitis cases was used. Proportional samples were collected from each cow at each milking and analysed for LDH and Somatic Cell Counts (SCC). The basis for the health definitions was vet treatment records. A refinement of the health definitions was made using systematic positive deviations in log(SCC) to indicate untreated infections. 2 subsets of cows were identified: mastitic cows and cows completely free of mastitis (healthy controls). The time-series profiles of these 2 groups in a 60-day window around day of vet treatment were examined. Model reliability throughout all stages of lactation and degrees of infection was examined using SCC as a continuous measure of degree of infection. The time-profile for the health controls was flat with a median Mastitis Risk of 0.02. In contrast, the profile of the mastitic cows increased above the control cows baseline from about -6 days, rising to a Mastitis Risk value of 0.20 at day 0, and declining back to the control cow level after treatment. Differences between mastitic and healthy cows were significant from –4 to +2 days from vet treatment. When cases were time-aligned to peak of infection rather than vet treatment there was a much sharper peak to the time-profile of mastitic cows. The median Mastitis Risk at peak was 0.62, the mean was 0.80, and the value of 0.62 had a less than 1% probability of actually coming from a healthy control. Testing against SCC on the whole dataset showed that only 2.1% of all Mastitis Risk values had an error greater than 0.7. This model is as accurate as the best published detection systems and was able to detect significant differences between mastitic and healthy cows 4 days before treatment.

Key Words: Mastitis Detection, Dairy Cow, Time Series

389 Effects of energy balance and *Streptococcus uberis* intrammamary infection challenge on gene expression profiles in bovine mammary tissue. K. M. Moyes*, J. K. Drackley, D. E. Morin, S. L. Rodriguez-Zas, R. E. Everts, H. A. Lewin, and J. J. Loor, *University of Illinois*, *Urbana*.

Cows experiencing severe postpartal negative energy balance (NEB) are at greater risk of developing mastitis than cows in positive energy balance (PEB). Objectives were to compare mammary tissue gene expression profiles during a *Streptococcus uberis* (*S. uberis*) mastitis challenge between lactating cows subjected to feed restriction to induce NEB (n = 6) and cows fed *ad libitum* to maintain PEB (n = 5). All cows had composite SCC <200,000 cells/mL prior to the study, and milk from all quarters was bacteriologically negative. Cows were paired based on parity, DIM, and milk yield. NEB cows were feed-restricted to 60% of calculated NE_L requirements for 7 d, and cows fed PEB were fed the same diet *ad libitum*. At 5 d after feed restriction, one rear mammary quarter of each cow was inoculated (IN) with 5,000 cfu of *S. uberis* (O140J). At 20 h post-IN, before the expected peak in clinical signs, both rear mammary quarters (IN and control) were biopsied for RNA extraction. A 13,257 oligonucleotide (70-mers) array and qPCR were used for transcript profiling. Annotation was based on similarity searches using BLASTN against human, mouse and bovine RefSeq, human, mouse, and bovine UniGene, and bovine TIGR. Cy3- and Cy5-labeled cDNA from mammary tissue and a reference standard were used for hybridizations. Energy balance (NEB vs. PEB) resulted in 347 differentially expressed genes (ANOVA $P < 0.05$) compared with 113 due to infection status (IN vs. control), and 23 genes for the interaction (energy balance × infection status). Among genes downregulated with NEB, Ingenuity Pathway Analysis identified small molecule biochemistry (20 genes), cancer (19), lipid metabolism (15), molecular transport (11), and cell morphology (10) as some of the most enriched molecular functions. Genes upregulated by NEB were associated with cell growth/proliferation (33), cell death (24), gene expression regulation (21), and cell signaling (19). Results indicate that energy balance and intramammary infection alter mammary gene expression.

Key Words: Genomics, Nutrition, Immune Response

390 The effect of negative energy balance on immune response to *Streptococcus uberis* mastitis challenge in dairy cattle during mid-lactation. K. M. Moyes*, J. L. Salak-Johnson, D. E. Morin, J. K. Drackley, and J. J. Loor, *University of Illinois*, *Urbana*.

Fourteen multiparous Holstein cows were used to determine effects of negative energy balance (NEB) on immune response to *Streptococcus uberis* (*S. uberis*) mastitis challenge during mid-lactation. Before the study, milk from all quarters of each cow were bacteriologically negative, with composite SCC < 200,000 cells/mL. Cows were paired based on parity, DIM and milk yield. At ~90 DIM, half of the cows were feed-restricted to 60% of calculated NE_L requirements based on body weight and milk production to induce NEB. Feed restriction lasted 7 d. Control cows were fed the same diet ad libitum (i.e. positive energy balance; PEB). Five d after feed restriction, one rear quarter in all cows was inoculated with 5,000 cfu of *S. uberis* (O140J). Health exams were performed, and jugular blood and aseptic quarter milk samples collected daily until inoculation and every 6 h post-inoculation for 36 h. Blood was analyzed for NEFA, BHBA, triglyceride (TG), glucose, cholesterol, and albumin. Blood neutrophils were isolated for determination of chemotaxis and phagocytosis capabilities *in vitro*. Quarter milk samples were analyzed for SCC and *S. uberis* concentration. Data were analyzed with the MIXED procedure of SAS with repeated measures. All cows developed local and/or systemic signs of mastitis after *S. uberis* inoculation. The NEB cows had higher ($P < 0.01$) blood concentrations of blood NEFA, BHBA, TG and cholesterol and lower ($P < 0.01$) glucose than PEB cows. Heart rate and rectal temperature were lower ($P < 0.05$) in NEB cows than PEB cows. Neutrophil phagocytic capability was greater ($P < 0.05$) in NEB cows than PEB cows. No differences were observed with regards to neutrophil chemotaxis, SCC, or *S. uberis* concentration in milk between groups. Our results suggest that cows subjected to nutrition-induced NEB had an enhanced immune response during mid-lactation.

Therefore, energy balance status might affect immune response to invading pathogens in periparturient cows.

Key Words: Energy Balance, Mastitis, Dairy Cattle

391 Multiplex PCR system for the detection of mastitis-causing pathogens. J. M. St-Pierre*, C. Thibault, and N. Bissonnette, *Agriculture and Agri-Food Canada*, *Sherbrooke, Quebec, Canada*.

Mastitis causes severe economic losses in the dairy industry each year. The need to understand the genetic factors implicated is therefore critical to help prevent the disease. Our project has many features to help determine which factors participate in the host's response to mastitis. The first phase of this experiment is to identify cows that are susceptible or resistant to the illness. As mastitis can be caused by multiple bacteria, the most prevalent ones are Escherichia coli, Staphylococcus aureus, Streptococcus agalactiae, Streptococcus dysgalactiae, Streptococcus uberis and Klebsiella pneumoniae. It has also been reported that Mycoplasma bovis is an important mastitic pathogen, but it is seldom identified because conventional culture methods can take up to 2 weeks and it is believed that it would most likely be a co-infection agent with Streptococci. We have designed a PCR multiplex system that amplifies specific genes for each of the bacterial species mentioned previously. Capillary electrophoresis is used to detect the PCR fragments as each pair of gene-specific primers is coupled to a fluorochrome that is detected by the laser of a genetic analyser. Because of the capacity of the genetic analyser to perceive many colors concurrently we are able to identify all 7 pathogens simultaneously even if they are not supposed to be present in mastitic milk at once. Therefore insuring that if an infection is caused by many microorganisms they will all be detected. The sensitivity of this method can be compared to that of microbiological methods and is more sensitive than a PCR on agarose gel though our test is more rapid than other PCRs because of the multiplexing component. Our system was tested with purified bacterial DNA. Further optimisation for the extraction of DNA directly from milk is required. As the technique is optimised we will be able to identify which animals come in contact with any of these bacterial species and develop or not the disease. This is a crucial step for our understanding of the genetic contribution to the mammary gland's immune system.

Key Words: Mastitis, Multiplex PCR, Pathogen

392 Efficacy of treatment protocols for Gram negative and no growth clinical mastitis in dairy cattle. J. R. Wenz*, *Washington State University*, *Pullman*.

The purpose of this study was to compare the efficacy of intramammary (IMM) ceftiofur hydrochloride (SP) with a protocol of no IMM antibiotics (NT) for the treatment of clinical mastitis with a Gram negative (GN) or (NG) culture result on a 1500 cow commercial dairy. Milk was aseptically collected from the affected quarter(s) of cows with systemically mild clinical mastitis for bacteriologic culture. Even numbered cows received SP (125 mg once a day for 5d). Odd numbered cows received NT. Outcomes evaluated were average days in sick pen (SPD), clinical recurrence in the same quarter 15-60d later (RECUR), loss of quarter (DRIED) and death/culling within 30d (D/C). SPD of cows with a GN culture result in the NT group were fewer than those in the SP group (P<0.0001). No difference was seen in cows with a NG culture result. The % of GN cows with >8 SPD was higher in the SP group than in the NT group (P=0.03), however, there was no difference for NG cows. There was no difference in RECUR or D&C between treatment groups, regardless of culture result. For cows with an NG culture result there were more cows in the NT group with a DRIED outcome compared with those in the SP group (P=0.02), however, there was no difference in GN cows. Results suggest SP treatment did not improve outcomes of cows with mild GN clinical mastitis compared to those receiving NT but may reduce loss of quarter in cows with mild NG clinical mastitis.

Table 1. Outcomes of mild clinical mastitis episodes by treatment and culture result

	GN		NG	
Outcome	NT	SP	NT	SP
SPD	6.0+/-2.1	8.6+/-3.0	7.4+/-5.1	7.5+/-1.8
%SPD>8d	3/27(11%)	11/29(38%)	20/81(25%)	24/85(28%)
RECUR	3/33(9.1%)	4/42(9.5%)	10/88(11%)	9/93(9.7%)
D/C	3/41(7.3%)	5/52(9.6%)	2/104(1.9%)	2/114(1.8%)
DRIED	1/41(2.4%)	2/52(3.8%)	15/104(14%)	6/114(5.3%)

Key Words: Mastitis, Gram Negative, Ceftiofur

393 The effect of uterine infusion of ceftiofur in the immediate postpartum on uterine health in dairy cows. R. G. Bruno*, M. F. Sa Filho, D. F. Resende, F. S. Lima, and J. E. P. Santos, *Veterinary Medicine Teaching and Research Center, University of California Davis*, *Tulare*.

Objective was to evaluate the effect of intrauterine antibiotic treatment on uterine health in dairy cows. Holstein cows, 379, were randomly assigned to no treatment (Control, n=188), or a single uterine infusion (Infusion, n=191) of 500 mg of ceftiofur hydrochloride (Spectramast DC, Pfizer Animal Health) at 2 d in milk (DIM). Cows were categorized as high risk for uterine disease if they had one or more of the following: major assistance at calving, deliver of twins, retained placenta, or milk fever. Uterine discharge was evaluated using the Metricheck (Simcrotech, Hamilton, New Zealand) at 2, 15 and 29 DIM, and classified based on the aspect, color and odor as normal, clinical endometritis and metritis. An aseptic uterine flush was performed at 36 DIM, and recovered fluid was subjected to microbiologic culture and cytological examination. A threshold of 18% of polymorphonuclear leukocytes as proportion of total cells (leukocytes + endometrial cells) in the cytology categorized cows with subclinical endometritis. Ovaries were examined twice by ultrasonography to determine cyclic status at 42 DIM. Data were analyzed using the LOGISTIC procedure of SAS (2001). Infusion reduced (P=0.06) the proportion of high-risk cows that required further antibiotic treatment (27.4 vs 45.8%), but did not influence (P>0.10) median mucus score at 15 (3 vs 4) and 29 DIM (2 vs 2). Incidence of metritis was similar (P=0.88) between treatments and affected 22.5 and 22.9% of Infusion and Control cows, respectively. Treatment did not affect (P>0.10) prevalence of positive uterine culture, Arcanobacterium pyogenes, or of subclinical endometritis, which affected 37% of the cows. High risk cows had greater (P<0.05) incidence of metritis (31.9 vs 16.2%), and cows with metritis were

more likely (P=0.03) to have positive uterine culture (61.0 vs 46.3%). Treatment did not (P=0.15) affect cyclic status at 42 DIM, but cyclic cows were less (P=0.02) likely to have A. pyogenes (7.8 vs 15.6%) and to be positive for subclinical endometritis (29.8 vs 44.5%). Single infusion with 500 mg of ceftiofur did not improve uterine health of dairy cows.

Key Words: Ceftiofur, Dairy Cow, Uterine Health

394 Metabolic profiles of dairy cows that develop metritis. J. M. Huzzey*[1], T. F. Duffield[2], S. J. LeBlanc[2], D. M. Veira[3], D. M. Weary[1], and M. A. G. von Keyserlingk[1], [1]*University of British Columbia*, *Vancouver, Canada*, [2]*University of Guelph*, *Ontario, Canada*, [3]*Pacific Agri-Food Research Centre*, *Agassiz, BC, Canada*.

The aim of this study was to describe the metabolic profiles of Holstein cows with severe metritis (SM; n=12), mild metritis (MM; n=27), and without metritis (n=23). Holstein dairy cows were monitored from 2 wks before to 3 wks after calving. Individual DMI was monitored continuously and serum NEFA, BHBA, calcium and haptoglobin were measured on d -20±5, -6±2, -2±1 and d 0 relative to calving, and then every 3 d until d+21. Vaginal discharge, rated on a 5-point scale, was assessed every 3 d until d+2; these scores and daily rectal temperatures were used to assess metritis severity. Clinical diagnosis of SM and MM was made on d 5.3±1.9 and d 9.1±3.9 after calving, respectively. NEFA levels were higher in the SM and MM cows relative to healthy cows on d-6 (P=0.02). On this day, cows with a NEFA concentration ≥0.3mmol/L were 4.3 times more likely to be diagnosed with severe or mild metritis (P=0.03). The sensitivity and specificity for this predictive threshold were 40% and 87%, respectively. There were no differences in BHBA among health groups. Calcium levels were lower in the SM cows, particularly between d+3 to d+12 after calving (P≤0.02), likely because DMI was lower in this group compared to healthy cows (P<0.01). Haptoglobin was 0.51g/L higher in the MM and 0.63g/L higher in the SM cows relative to the healthy animals between d0 and d+12 (P<0.05), with peaks on d +3 for the healthy and MM cows and on d+6 for the SM cows. On d+3 cows with a haptoglobin concentration of ≥1g/L were 6.3 times more likely to develop severe or mild metritis (P=0.004). The sensitivity and specificity for this predictive threshold were 49% and 87%, respectively. Because differences in measures of energy metabolism and inflammation occurred before metritis developed, NEFA concentrations at d-6 and haptoglobin concentrations at d+3 relative to calving may be useful for monitoring the risk of metritis in dairy cows.

Key Words: Metabolites, Metritis, Periparturient

395 JDIP – Direction for Johne's research. K. E. Olson*[1], S. J. Wells[2], and V. Kapur[2], [1]*KEO Consulting*, *Schaumburg, IL*, [2]*University of Minnesota*, *St. Paul*.

The Johne's Disease Integrated Program (JDIP) is a consortium whose mission is to promote animal biosecurity through development and support of projects that enhance knowledge, promote education, develop real-world solutions and mitigate losses from Johne's disease (JD). Approximately 140 individuals from 30+ academic, government and industry organizations are part of JDIP. A primary benefit is the networking that facilitates translation of results from cutting edge research programs to practical solutions with field application. Primary funding is from a USDA–CSREES–NRI CAP program competitive grant. Through JDIP, Johne's research and education needs are prioritized, with modest competitive grants awarded to address priorities. The initial round of funding ends in 2007. Five project areas have been identified for future JDIP activity: Project 1 – Epidemiology and Transmission - Determine within farm transmission dynamics of *Mycobacterium avium subsp paratuberculosis (MAP)* along with its molecular epidemiology and evaluate effectiveness of recommended management practices on reducing the incidence of infection; Project 2 – Diagnostics and Strain Differentiation – Use information gained from initial JDIP projects to develop and validate more accurate, rapid diagnostic tests, and tools to better quantify positive samples; Project 3 – Basic Biology and Pathogenesis – Build on prior work to develop a better understanding of mechanisms that impact virulence and survivability of *MAP*, helping to improve diagnostics and identify vaccine candidates; Project 4 – Host Genetics, Immunology, and Vaccine Development – Identify genetic markers for susceptibility to JD in cattle, compare efficacy of mutant vaccines in animal models, test candidate vaccines on the immune response and in vivo survival of *Map*; Project 5 – Education and Extension – Complete national survey of barriers to participation in JD program, identify stakeholder educational needs and design programs to meet them. Increase awareness of JDIP by outreach to producer media and meetings. The JDIP program is developing a strong translational pipeline for development of real world solutions to mitigate losses associated with JD.

Key Words: Johne's Disease, MAP, JDIP

396 Serum non-esterified fatty acid (NEFA) and beta-hydroxybutyrate (BHB) through the transition period of Holstein cows in different regions of North America. M. E. Carson*[1], T. F. Duffield[1], S. J. LeBlanc[1], K. E. Leslie[1], S. M. Godden[2], M. B. Capel[3], M. W. Overton[4], and D. Vallejo[5], [1]*University of Guelph*, *Ontario, Canada*, [2]*University of Minnesota*, *St Paul*, [3]*Perry Veterinary Clinic*, *Perry, NY*, [4]*University of Georgia*, *Athens*, [5]*University of California, Davis*, *Tulare*.

The objective of this field study was to evaluate the concentrations of serum non-esterified fatty acid (NEFA) and beta-hydroxybutyrate (BHB) through the transition period of Holstein cows in four different regions. Data were collected from 1812 cows in 45 herds across Midwest, Northeast (including Ontario, Canada), Southeast and Western United States. Each herd in the Midwest and Northeast regions had approximately 35 cows per herd enrolled in the study, whereas in the Southeast and Western herds included approximately 60 and 80 cows per herd, respectively. Cows were sampled 1 week prior to the expected calving date, and again in weeks 1, 2, and 3 postpartum. All serum collected was shipped to the Animal Health Laboratory at the University of Guelph for NEFA and BHB analysis. Results for NEFA and BHB by region and time relative to calving are shown in Table 1. Cows in the West showed a smaller prevalence of NEFA levels ≥0.4 mmol/L in the week prior to parturition, whereas herds in the Northeast had the greatest prepartum NEFA with 44% of cows ≥0.4mmol/L. Similarly, the Northeast had the greatest mean BHB at week 1 postpartum. The prevalence of subclinical ketosis in week 1 postpartum was greatest in Northeast and Midwest herds and smallest in West and Southeast herds. It appears that regional differences may exist for

serum NEFA and BHB levels and prevalence of subclinical ketosis during the transition period. The reasons for these apparent differences merit further investigation.

Table 1. Distribution of prepartum non-esterified fatty acid (NEFA) and postpartum beta-hydroxybutyrate (BHB) concentrations in dairy cows in North America.

Region	No. of Cows	No. of Herds	Mean (±SD) NEFA	Proportion of cows with high NEFA (≥0.4 mmol/L)	Mean (± SD) BHB	Proportion of cows with subclinical ketosis (BHB ≥1400 µmol/L)
Midwest	570	17	0.38 (±0.3)	39%	940 (±715)	15%
Northeast	652	20	0.41 (±0.3)	44%	1044 (±772)	20%
Southeast	177	3	0.37 (±0.3)	40%	867 (±1015)	8%
West	413	5	0.26 (±0.2)	20%	798 (±569)	9%

Key Words: Dairy Cows, Transition, Metabolic Parameters

397 An evaluation of meloxicam (Metacam®) as an adjunctive therapy for calves with neonatal calf diarrhea complex. C. G. Todd*[1], D. R. McKnight[2], S. T. Millman[1], T. F. Duffield[1], and K. E. Leslie[1], [1]*University of Guelph*, *Guelph, ON, Canada*, [2]*University of Guelph*, *Kemptville, ON, Canada*.

Diarrhea is a significant health problem among neonatal dairy calves. In some countries, calves with diarrhea may be treated with supportive therapies, such as non-steroidal anti-inflammatory drugs. The aim of this research was to examine the efficacy of meloxicam as an adjunctive therapy for calves with diarrhea, as determined by measures of calf performance, behavior and health. For this double-blind controlled trial, 62 Holstein bull calves were purchased at birth and transported to a calf research facility. At the naturally occurring onset of diarrhea, the calves were enrolled in the study, and randomly assigned to receive a single subcutaneous injection of meloxicam (0.5 mg/kg BW) or an equal volume of placebo solution. Individual milk, water and calf starter ration intakes were determined daily for all calves until 56 days of age. Daily fecal consistency scores and weekly body weight measurements were also collected for each study calf. Following the onset of diarrhea, calf feeding behavior and general activity, as well as lying and standing postures were observed for five consecutive days. During this trial, 56 calves developed diarrhea and were treated with meloxicam (n=28) or placebo (n=28). Meloxicam-treated calves began consuming starter ration significantly earlier than placebo calves ($p<0.05$), had improved starter intakes ($p<0.05$) and experienced greater body weight gain over the study period ($p<0.05$). There was no difference in weaning weight among the study calves ($p>0.05$); however, meloxicam-treated calves tended to wean at an earlier age (47 days versus 41 days, respectively, $p=0.16$). Compared to calves receiving placebo, meloxicam-treated calves were more sedentary for the first two days after developing diarrhea, and then became considerably more active during the remainder of the observation period ($p<0.05$). The occurrence of abnormal lying postures did not differ among the study calves ($p>0.05$). These results provide evidence of improved calf well-being and indicate that meloxicam may be an appropriate supportive therapy for calves with diarrhea.

Key Words: Calf, Diarrhea, Non-steroidal Anti-inflammatory Drug Therapy

398 A diagnostic algorithm, in a dashboard environment for common dairy cow health concerns. D. T. Galligan*[1], D. Remsburg[1], J. Ferguson[1], R. Munson[1], and G. Licitra[2,3], [1]*University of Pennsylvania*, *Kennett Square*, [2]*CoRFiLaC, Regione Siciliana*, *Ragusa, Italy*, [3]*DACP University of Catania*, *Catania, Italy*.

Dairy producers are often confronted with cows displaying various clinical signs indicative of various **health conditions** (ketosis, DA (+/- torsion), mastitis, RP, metritis, pneumonia, hardware, lameness, milk fever etc). The interpretation of these clinical signs (heart rate, temperature, respiration, rumen sounds, posture, neurological signs, ketosis test results, serum protein level) as well as historical information (lactation number, production profile etc) will often determine a **presumptive diagnosis** as well as a standard treatment response. The presumptive diagnosis in this program is based on an algorithm that looks at the hierarchy of clinical signs associated with a disease condition. A graph of the relative % matching signs for each of the disease condition is presented to the user as well as a treatment window for the conditions diagnosed. Often the decision to treat a cow is based on her expected value relative to a replacement (or alternative opportunity) as well as the immediate therapeutic cost and expected prognosis to the current condition. The expected prognosis is based on the increased risk of culling associated with the difference diagnosed conditions. A dashboard (Flash) file was developed with the algorithm based on interviewing several veterinarians with considerable practice experience and reports in the literature estimating the increased odds of culling due to a given condition. The dashboard environment allows the use of sliders for data entry and a response gauge estimating survival to the next lactation. The program can be run on a stand alone computer or off the web.

Key Words: Health, Algorithm

399 Effects of reduced freestall access during the dry period upon cellular immune function and transition health of dairy cows. T. F. Gressley*, K. K. Fried, J. M. Velasco, E. D. Reid, T. C. Hausman, K. M. Moyes, J. L. Salak-Johnson, and G. E. Dahl, *University of Illinois*, *Urbana*.

The objectives of this study were to determine if limiting freestall access of dry cows impacted immune function or transition health. Our model examined one aspect of overcrowding, reduced freestall availability, without changing feed access, water availability, or area per cow. Twenty Holstein cows were randomly assigned to either a 70% stall availability treatment (70SA; n=10) or a 100% stall availability treatment (100SA; n=10) 1 wk following dry off on d 51 ± 6 prior to expected calving. Cows on the 70SA treatment only had access to 7 freestalls in a 10-freestall bay, whereas cows on the 100SA treatment had access to all 10 freestalls. Short-term treatment effects on neutrophil phagocytosis and chemotaxis and lymphocyte proliferation were measured 4 and 24 h after treatment assignment. Lymphocyte proliferation was measured again at 2 and 5 wk post-treatment. Locomotor scores and postpartum disease prevalence were also recorded for these 20 cows and a second cohort of 20 cows subjected to the same treatments. In the short-term, immune cell activity was enhanced among cows on the 70SA treatment compared to cows on 100SA. Lymphocyte proliferation was increased in response to ConA ($P = 0.02$) and tended to increase in response to PHA ($P = 0.14$), suggesting an increased responsiveness of T-cells. The percentage of neutrophils engulfing 1 or more fluorescent beads was greater

among 70SA cows than the 100SA cows (P < 0.05). Long-term there was a tendency for cows in the 70SA treatment to have increased LPS-induced B-cell proliferation compared to 100SA cows (P = 0.09). Postpartum disease prevalence was similar for cows on both treatments. There were interactions between treatment and cohort and week and cohort on locomotor score (P < 0.05). Locomotor score did not change over time for cohort 1 cows or for the 100SA cows in cohort 2, but it worsened over time for the 70SA cows in cohort 2. A moderate reduction in freestall access in dry cow facilities should not adversely affect immune function, but it may negatively impact hoof health.

Key Words: Transition Cows, Freestall Availability, Immune Function

Beef Species I

400 Post-weaning growth performance of heifers grazing Tasmanian native pastures and the estimation of inbreeding levels using random amplified polymorphic DNA markers. A. E. O. Malau-Aduli*[1] and M. Dunbabin[2], [1]*University of Tasmania*, *Hobart, Tasmania, Australia*, [2]*'Bangor', Dunalley*, *Tasmania, Australia*.

The aims of this study were to evaluate the growth performance of Hereford, Angus, Hereford × Angus and Hereford × Saler heifers within the same herd grazing native pastures and to estimate homozygosity and inbreeding coefficients using random amplified polymorphic DNA (RAPD) markers. Post-weaning liveweight (BW), average daily gain (ADG) and body condition score (BCS) on a scale from 0 to 5 were monitored monthly from 2005 to 2006. Genomic DNA was extracted from blood samples, amplified using RAPD primers, fragments resolved by gel electrophoresis and banding patterns elucidated under UV light. Estimation of homozygosity through band sharing patterns was utilised in determining within-breed inbreeding levels. Regardless of breed, LWT, BCS and ADG of heifers followed a typical sigmoid curve pattern characterised by a decline in average BW from 200 kg in May to 188 kg in June, a continuous monthly increase through to March 2006 when it reached a peak (380 kg) before a final decline to 375 kg in May. The BCS ranged from 1.6 to 3.6 while ADG ranged from -0.4 to 1.5 kg/d. Significant genetic variation was observed between the different breeds in that BCS and BW of purebred Angus heifers were lower than those of purebred Hereford and their crosses with Angus and Saler. Average BW of the Angus breed ranged from 164-349 kg, with BCS ranging from 1.4 to 3.3 compared to the Hereford (186-383 kg, 1.6-3.6), Hereford × Angus (192-383 kg, 1.7-3.6) and Hereford × Saler (192-385 kg, 1.6-3.7), respectively. The ADG of the Angus was not different from those of Hereford and their crosses indicating that the Angus was perhaps better in terms of feed efficiency since they probably ate less and gained the same weight as the heavier breeds that must have eaten more commensurate with their maintenance requirements. The strongest residual correlation (r=0.98) was between BW and BCS. Average band sharing frequencies ranged from 0.60 in the crossbreds to 0.96 in the purebreds with estimated inbreeding coefficients ranging from 0.5% to 3%, respectively, which is very low.

Key Words: RAPD Markers, Post-weaning Growth, Beef Cattle

401 Influence of breed on postpartum interval and estrous cycle length in beef cattle. R. A. Cushman*, M. F. Allan, R. M. Thallman, and L. V. Cundiff, *USDA, ARS, Roman L. Hruska U.S. Meat Animal Research Center*, *Clay Center, NE*.

Before genetic markers can be generated for fertility in beef cows, greater characterization of reproductive phenotypes is needed. The present study tested the hypotheses that 1) breeds vary in postpartum interval (PPI) and estrous cycle length, 2) a longer estrous cycle immediately prior to breeding increased pregnancy rates, and 3) a greater number of cycles prior to breeding increased pregnancy rates. Postpartum interval, estrous cycle length, and number of cycles prior to breeding were examined in F1 cows (n = 519) obtained from mating Hereford, Angus and USMARC III cows to Hereford, Angus, Simmental, Limousin, Charolais, Gelbvieh, and Red Angus sires. Cows were classified as having 0, 1, 2, or 3 observed estrous cycles prior to breeding, and breed effects on PPI, number of cycles, and estrous cycle length were examined using the MIXED procedure of SAS. Sire breed of the cow influenced the length of the PPI and number of cycles prior to the start of breeding (P < 0.001). Simmental-sired cows had the shortest PPI and greatest number of cycles prior to breeding; Limousin-sired cows had the longest PPI and least number of cycles prior to breeding. Cows with a greater number of cycles prior to breeding did not have greater pregnancy rates than cows that had not exhibited estrus prior to breeding (P = 0.87). In cows that cycled prior to breeding, the length of the estrous cycle immediately prior to breeding was influenced by dam breed and body condition score (BCS, P < 0.01). Cows out of Hereford dams had shorter estrous cycles than cows out of USMARC III or Angus dams, and estrous cycle length increased as body condition score increased. Pregnancy rate decreased as length of the estrous cycle prior to breeding increased (P = 0.05, -2.2% per day of cycle length), suggesting that there may be an influence of length of the estrous cycle immediately prior to breeding on conception rates due to prolonged follicles with lower quality oocytes. Breed differences in PPI and estrous cycle length suggest that there are genetic components to these traits.

Key Words: Beef Breeds, Pospartum Interval, Reproductive Efficiency

402 Effect of an artificial sweetener and yeast product combination on immune function measurements, growth performance, and carcass characteristics of beef heifers. R. R. Reuter*[1,2], J. A. Carroll[2], M. S. Brown[3], N. E. Forsberg[4], Y.-Q. Wang[4], R. Mock[5], J. D. Chapman[6], and M. L. Galyean[1], [1]*Texas Tech University*, *Lubbock*, [2]*USDA-ARS Livestock Issues Research Unit*, *Lubbock, TX*, [3]*West Texas A&M University*, *Canyon*, [4]*Oregon State University*, *Corvallis*, [5]*Texas Veterinary Medical Diagnostic Laboratories*, *Amarillo, TX*, [6]*Prince Agri-Products*, *Quincy, IL*.

One hundred ninety-nine crossbred beef heifer calves (205 ± 7.9 kg initial BW) were used in a 44-d receiving trial with 2 dietary

treatments (9 pens/treatment) in a completely random design. Diets were a steam-flaked corn- and alfalfa hay-based control (CON) diet or the same diet (ADD) with added artificial sweetener (Sucram; Prince Agri-Products; 198 mg/kg of diet DM) and a source of yeast and B-complex vitamins (OmniGen-AF; Prince Agri-Products; 0.8% of diet DM). Heifers were weighed and bled on d 0, 16, 30, and 44 after arrival at the feedlot. Serum was collected from jugular venipuncture blood samples and analyzed for cortisol, cytokine, and acute-phase protein concentrations, L-selectin expression, and respiratory virus titer. At d 44, the heifers were transported to a commercial feedlot, fed for 200 d, and individual carcass data were collected at slaughter. Morbidity (9.5%) and mortality (0.5%) were less than expected and not affected by treatment ($P > 0.63$). On d 16, ADD decreased ($P < 0.001$) haptoglobin concentration, but diet did not affect ($P > 0.43$) other measures of immune function. Diet had no effect on ADG, DMI or G:F ($P > 0.32$) in either the initial 16-d after arrival or the overall 44-d receiving period. Receiving period diet had no effect on carcass characteristics, except that ADD decreased marbling score ($P = 0.045$), marbling score adjusted to a constant fat thickness ($P = 0.08$), and tended ($P = 0.11$) to decrease percentage of heifers that graded USDA Choice. Results were inconsistent with previous research, possibly because animals were not exposed to the treatments prior to the stress period and did not experience a substantial pathogen challenge.

Key Words: Beef Cattle, Immune Function, Sweetener

403 Evaluation of the effects of two commercially available modified live vaccines for bovine respiratory disease complex on naïve beef steers. W. J. Horne*[1], K. S. Barling[2], A. D. Herring[1], D. K. Lunt[1,3], A. Thomas[2], and J. E. Sawyer[1], [1]*Texas A&M University Department of Animal Science*, *College Station, TX*, [2]*Novartis Animal Health US, Inc*, *Larchwood, IA*, [3]*McGregor Agricultural Research Center*, *McGregor, TX*.

A study was conducted to evaluate effects of two commercially available modified live respiratory vaccines (MLV) on performance and antibody formation in beef steers. Naïve (confirmed seronegative to IBR and BVDV Types 1 & 2) beef steers (n = 107) were stratified by BW and randomly assigned to treatment within strata. Treatments consisted of either vaccine A (Type 1 BVD, IBR, PI3, BRSV), vaccine B (Types 1 & 2 BVD, IBR, PI3, BRSV), or control (physiological saline) administered SQ. Animals were fed individually in Calan™ gates with rectal temperature (RT) (d 0, 1 3, 7, 14, 28), body weight, BVDV Type 1, BVDV Type 2, and IBR titer responses collected serially (d 0, 14, 28, 42) post-vaccination. Data were analyzed as repeated measures in time using mixed models procedures. At d 14, no differences existed for BVDV Type 1 or Type 2 antibody titers. At d 28 and 42, steers receiving B had the highest (P<0.01) BVDV Type 1 titer response: A produced higher titers (P<0.01) than control. At d 28, steers receiving B had a greater (P<0.01) BVDV Type 2 titer response than A- and control-treated steers. On d 42, B generated the highest (P<0.01) titer response: A was greater (P<0.01) than controls. Titers for IBR on d 14, 28, and 42 were greatest in steers receiving A (P<0.01): B produced higher IBR titers than control (P < 0.01). Treatment had minimal effect on RT. Time affected RT (P < 0.01), which declined through d 3, increased through d 14, and then stabilized. A treatment by day interaction occurred for ADG (P<0.01). Gain declined throughout the study for steers receiving control or B. For steers receiving A, ADG was higher (P<0.01) for the middle third of the feeding period, such that overall ADG was similar for all treatments (P = 0.10). Inoculation with vaccine B resulted in the highest increase in BVDV Type 1 and 2 titers, without decreasing overall ADG relative to other treatments. Vaccine A produced the highest IBR titers. Vaccination with a MLV can create adequate immune responses without negatively altering feeding performance of beef steers.

Key Words: Modified Live, Vaccine, Bovine

404 Management factors affecting selling prices of Arkansas beef calves: 2000 vs. 2005. B. L. Barham and T. R. Troxel*, *University of Arkansas Cooperative Extension Service*, *Little Rock, AR*.

Five USDA certified livestock market reporters collected data from weekly livestock auctions in Arkansas from January 1 to December 31 in both 2000 and 2005. The market reporters collected information from 17 markets in 2000 and 15 markets in 2005. The data collected included calf gender, horn status, fill, condition, health, weight and price. A total of 533,283 feeder cattle were sold through these livestock auctions in 2000, and data was randomly collected on 81,703 (15.3%) head. A total of 581,413 feeder cattle were sold through these livestock auctions in 2005, and data was randomly collected on 52,401 lots consisting of 105,542 (18.2%) head. The average selling prices for 2000 and 2005 were $92.91 and $118.32/45.45 kg, respectively. Data were analyzed by subtracting the actual selling price from the average selling price for the given year. All dollar value results are reported as a deviation from the respective year mean and expressed as dollars/45.45 kg. Arkansas cow-calf producers castrated more (8.9%) bull calves before selling in 2005 than in 2000 (P < 0.01). Buyers paid a higher premium for steers ($6.48 vs. $6.02; P < 0.0001) and paid less for bull calves ($0.30 vs. $1.68; P < 0.001) in 2005 than in 2000. Additionally, cattle buyers discounted horned cattle greater in 2005 than 2000 (-$2.86 vs. -$0.51; P < 0.0001). Thin cattle in 2000 received a discount (-$1.91) but in 2005 received a premium ($1.67). The percentage of calves with dead hair, stale, sick, bad eye(s) and lame was low in 2000 and even lower in 2005 (P < 0.01). Arkansas cow-calf producers sold more calves in groups (26% vs. 19%; P < 0.01) and fewer calves individually in 2005 than they did in 2000 (75% vs. 81%; P < 0.01). Buyers paid a higher premium for cattle sold in groups in 2005 than in 2000 ($4.05 vs. $3.09; P < 0.001). Cow-calf producers can do more to improve the quality and selling price of feeder cattle by making genetic selection and management changes.

Key Words: Beef Cattle, Selling Price, Price Comparisons

405 Impact of the phenotypic expression of calf genetics on the selling price of calves sold in Arkansas livestock markets: 2000 vs. 2005. B. L. Barham* and T. R. Troxel, *University of Arkansas Cooperative Extension Service*, *Little Rock, AR*.

Five USDA certified livestock market reporters collected data from weekly livestock auctions in Arkansas from January 1 to December 31 in both 2000 and 2005. The market reporters collected information from 17 markets in 2000 and 15 markets in 2005. The data collected included breed or breed type, color, muscle thickness, frame score, weight and price. A total of 533,283 feeder cattle were sold through these livestock auctions in 2000, and data was randomly collected on 81,703 (15.3%) head. A total of 581,413 feeder cattle were sold through

these livestock auctions in 2005, and data was randomly collected on 52,401 lots consisting of 105,542 (18.2%) head. The average selling prices for 2000 and 2005 were $92.91 and $118.32/45.45 kg., respectively. Data were analyzed by subtracting the actual selling price from the average selling price for the given year. All dollar value results are reported as a deviation from the respective year mean and expressed as dollars/45.45 kg.. More number 2 muscle score cattle and fewer number 1, 3 and 4 muscle score cattle were sold in 2005 than 2000 ($P < 0.01$). In 2005, buyers paid a higher premium for muscle score 1s than in 2000 ($2.58 vs. $0.02; $P < 0.0001$). The Arkansas cow-calf producer marketed more large-framed and fewer medium- and small-framed calves in 2005 than in 2000 ($P < 0.01$). The cattle breeds or breed types that increased in value from 2000 to 2005 were Angus x Hereford, Angus, Angus x Charolais and Brahman ($P < 0.0002$). Buyers discounted Charolais x Limousin, Charolais, Charolais x ¼ Brahman, Hereford x Limousin, Hereford x Charolias, Limousin, Limousin x ¼ Brahman, Simmental, Saler, Longhorn and ¼ Brahman Cross more in 2005 than in 2000 ($P < 0.01$). The calf colors that received an increase in selling price were yellow-white face, black-white face, grey-white faced, black and gray. White, red-white face and red calves were discounted in 2005 compared to 2000. Cow-calf producers can do more to improve the quality and selling price for the feeder cattle by making genetic selection and management changes.

Key Words: Feeder Cattle, Selling Price, Beef Calves

406 Carcass trait characterization of retained and purchased Alabama feeder calves. S. V. Free*, W. C. Rutherford, J. B. Elmore, G. S. Hecht, and L. A. Kriese-Anderson, *Auburn University*, *Auburn, AL*.

Alabama Beef Connection (ABC) (n=6,222) and Alabama Pasture to Rail (P2R) (n=901) cattle carcass traits were analyzed to compare Alabama feeder cattle finished in the High Plains region of the United States. Cattle consigned to P2R were retained, co-mingled loads of cattle having known birth dates and parentage. ABC-enrolled cattle were usually load lots of feeder cattle sold as calves by cow/calf producers desiring carcass data. Some ABC-enrolled cattle were load lots of retained or co-mingled feeder calves. Traits of hot carcass weight (HCW), 12th rib fat (BF), longissimus dorsi area (REA), USDA yield grade (YG) and marbling score (MS) were analyzed in SAS using a general linear model. Fixed effects included cattle year of enrollment (2003-2006), market method (tele-auction (TA), private treaty (PT), retained (RT) or co-mingled retained (CT)), and data source (P2R or ABC). The traits BF, MS, REA, and YG were analyzed with a covariate of harvest date or HCW. Harvest date served as a covariate for HCW. With either covariate of harvest date or HCW, market method and year were significant sources of variation ($P<0.05$). The TA carcasses were the lightest. With either covariate RT and CT carcasses had significantly more BF than TA or PT cattle. These results were similar for YG. Using HCW as a covariate for YG, ABC calves had significantly higher YG than P2R calves ($P<0.05$). For REA, only HCW was a significant covariate. The TA and PT carcasses had the largest REA followed by CT and RT ($P<0.05$). P2R carcasses had larger MS than ABC carcasses ($P<0.05$). For both covariates, TA and RT carcasses had higher ($P<0.05$) MS than CT. No differences were detected between PT and RT carcasses for MS. Despite these differences of carcass traits among various marketing methods of Alabama cattle, all values fell within the accepted industry carcass standards.

Key Words: Beef Cattle, Carcass Traits, Marketing

407 Carcass trait characterization of Alabama feeder calves fed in two regions of the United States. W. C. Rutherford*, S. V. Free, J. B. Elmore, G. S. Hecht, and L. A. Kriese-Anderson, *Auburn University*, *Auburn, AL*.

To assess the carcass quality of Alabama born cattle, carcass data from cattle (n=7,144) fed in two regions (Midwest (MW) and High Plains (HP)) were analyzed. All cattle were sold as feeder calves through a tele-auction (TA) or private treaty (PT). Market option (MO), region (R) and their interaction was used in a general linear model in SAS to analyze data. Model A used harvest date (KD) as a covariate and Model B used hot carcass weight (HCW). Traits analyzed were hot carcass weight (HCW), 12th rib fat thickness (BF), marbling score (MB), USDA yield grade (YG) and longissimus dorsi area (REA). Region, R × MO and KD were significant for HCW ($P < 0.05$). The MW × TA cattle had heavier HCW than HP × PT ($P < 0.05$). Both had heavier HCW than MW × PT and HP ×TA which were similar. Region, MO, R × MO and KD were significant for BF ($P< 0.05$). The HP × TA cattle had significantly less BF than the other three interaction classes ($P < 0.05$). The R × MO interaction was significant for MB. The HP × TA cattle had significantly more MB compared to the other three interaction classes ($P< 0.05$), which were similar. Region and the R × MO interaction were significant for YG ($P < 0.05$). The R × MO effect was significant for YG. The MW × PT cattle had significantly better YG than the other three interaction classes ($P < 0.05$). Region, MO and KD were all significant for REA ($P < 0.05$). The HP-fed cattle had significantly larger REA than cattle fed in the MW ($P < 0.05$) and TA cattle had significantly larger REA than PT cattle ($P < 0.05$). Model B showed covariate HCW was significant for BF ($P <.05$). R, MO and HCW were all significant for MB ($P <.05$). HP fed cattle had more MB than the MW fed cattle ($P <.05$) and TA cattle had more MB than PT cattle ($P <.05$). The HP-fed cattle had significantly more MB than the other three interaction classes ($P < 0.05$). The MO, R × MO and HCW were significant for YG ($P < 0.05$). The MW × PT cattle had a significantly better YG than the other three interaction classes. Region and R × MO significantly affected HCW ($P < 0.05$). The HP-fed cattle had larger REA than the MW-fed cattle. Carcass data from these Alabama feeder calves is comparable to data of the 2000 National Beef Quality Audit.

Key Words: Beef Cattle, Carcass, Quality

408 Comparison of carcass trends of Alabama cattle with national quality audit reports. J. B. Elmore*, L. A. Kriese-Anderson, W. C. Rutherford, S. V. Free, G. S. Hecht, and W. F. Owsley, *Auburn University*, *Auburn, AL*.

Since 1991, national beef quality audits have been concerned with increasing hot carcass weight and stagnant USDA quality grades. Data from two sources containing carcass data from Alabama feeder calves were analyzed to determine if Alabama carcass trends were similar to

national trends. Hot carcass weight (HCW), 12th rib fat thickness (BF), longissimus dorsi area (REA), USDA yield grade (YG) and USDA marbling score (MS) were analyzed using records from the Alabama Beef Connection (ABC) and Alabama Pasture to Rail Program (P2R). The ABC database contained 5,160 records from 2003 to 2006 on cattle sold as feeder calves and fed primarily in the Midwest and High Plains regions of the United States. The P2R database contained 4,997 records from 1994 to 2005 of co-mingled retained ownership cattle fed in the High Plains region of the United States. Data were analyzed using a general linear model in SAS. Fixed effects included year, breed of sire and region fed. A covariate of harvest date was included for all traits. The HCW of Alabama feeder cattle have not followed audit trends. Hot carcass weights have tended to increase nationally (344 to 361 kg). In P2R cattle, HCW has significantly decreased from 352 kg in 1994 to 335 kg in 2005. The ABC cattke show a similar trend (392 kg in 2003 to 351 kg in 2006, $P<0.05$). In both data sets, REA remained stable across all years (P2R 87.04 cm^2; ABC 88.11 cm^2, audit 84.5 cm^2). The MS trend was significantly positive across years in both datasets. The P2R data from 1994 moved from a MS of 411 to 484 in 2006 ($P<0.05$). The ABC data from 2003 to 2006 moved from a MS of 484 to 490 ($P<0.05$). Back fat and YG were the most variable carcass traits for Alabama across years with positive and negative trends ($P<0.05$). Feedlot, market conditions and weather probably affected these traits as much as genetic predisposition. Alabama cattle are generally YG 2 cattle (P2R 2.54 vs. ABC 2.56; audit 3.0). This is primarily due to 3.23 cm^2 more REA than required for the associated HCW. Alabama results do not agree with audit findings of increased HCW and REA over time.

Key Words: Beef Cattle, Carcass Characteristics, Beef Quality

Breeding and Genetics - Livestock and Poultry: Analyses and Methods I

409 Using epidemiological models and genetic selection to identify theoretical opportunities to reduce disease impact. G. D. Snowder*, *USDA, ARS, U.S. Meat Animal Research Center*, *Clay Center, NE*.

Selection for disease resistance is a contemporary topic with developing approaches for genetic improvement. Merging the sciences of genetic selection and epidemiology is essential to identify selection schemes to enhance disease resistance. Epidemiological models can identify theoretical opportunities for genetic selection to reduce the impact of a disease. Potential selection venues may be more appropriately comprehended by compartmentalization of disease components using epidemiological models. This study considers the standard Susceptible, Infected, Recovered (SIR) epidemiological model and five other common epidemiological models (MSIR, SEIR, SIS, Carrier State, and SIR Vector) with genetic selection alternatives. Theoretical modeling of genetic selection effects on epidemiological models were used to: predict the economic effect of selection, estimate the optimal number of resistant animals to prevent an epidemic, and determine genetic selection alternatives. Selection alternatives to genetic disease resistance include lowering the probability of being infected, tolerance for the pathogen, longer latency period, less severe clinical expression, faster recovery rate, and compensatory rebound. These selection alternatives can result in favorable changes to the differential equations for susceptibility, infected, and recovery rates. Potentially undesirable consequences due to selection can be predicted, such as an increase in the size of sub clinical populations harboring and shedding pathogens. When applied to actual data for bovine respiratory disease, this approach identifies the complexity of genetic resistance to this disease while detecting potential opportunities for genetic selection. When a disease such as bovine respiratory disease is caused by different pathogens (bacterial, viral, mycoplasmal, etc.) with different pathways of infection, the probability of reducing the disease prevalence with genetic selection is diminished.

Key Words: Animal Breeding, Cattle, Disease Resistance

410 Assessment of different selective phenotyping design strategies for genetical genomics studies with outbred F2 populations. F. F. Cardoso*[1,2], J. P. Steibel[1], G. J. M. Rosa[3], C. W. Ernst[1], R. O. Bates[1], and R. J. Tempelman[1], [1]*Michigan State University*, *East Lansing*, [2]*Embrapa Pecuária Sul*, *Bagé, RS, Brazil*, [3]*University of Wisconsin*, *Madison*.

Quantitative genetic analysis of transcriptional profiling experiments is emerging as a promising approach to discover candidate genes underlying variation of complex biological traits. However, adoption of these genetical genomics approaches is currently limited by the high cost of microarrays. We studied variants of three recently proposed design strategies to optimally select subsets of individuals for transcriptional profiling including maximizing genetic dissimilarity between selected individuals, maximizing the number of recombination events in selected individuals, and selecting phenotypic extremes within genotypes of a previously identified quantitative trait locus (QTL). We also investigated two other options, namely purely random selection and profiling animals with the highest and lowest phenotypic values within each family-gender subclass. A simulation study was conducted based on linkage map and marker genotypes provided from a dataset on Chromosome 6 for 510 F2 animals from an actual pig resource population. Comparisons between methods were based on a biallelic QTL with pleiotropic effects on a phenotypic trait and a particular expression profile. The model included an overall mean, fixed additive QTL and sex effects and random polygenic and family effects. Bivariate (gene expression with phenotypic data) mixed model analyses were conducted for subset selection intensities of 80/510, 160/510 and 240/510. All methods were deemed to be similar for the mean absolute distance of the estimated QTL to the true QTL location. Precision and bias of estimates of QTL effects was further assessed by their Mean Square Error (MSE). The genetic dissimilarity and extremes within genotype methods had the smallest MSE and maximum sensitivity, outperforming all other selection strategies, particularly at the smallest proportion of selected samples (80/510).

Key Words: Genetical Genomics, Selective Phenotyping, QTL

411 Different methods of selecting animals for genotyping to maximize the amount of genetic information known in the population. M. L. Spangler*[1], R. L. Sapp[2], J. K. Bertrand[1], M. D. MacNeil[2], and R. Rekaya[1], [1]*University of Georgia*, *Athens*, [2]*USDA-ARS Fort Keogh Livestock and Range Research Laboratory*, *Miles City, MT*.

It is possible to predict genotypes of some individuals based on genotypes of relatives. Different methods of sampling individuals to be genotyped from populations were evaluated using simulation. Simulated pedigrees included 5,000 animals and were assigned genotypes based on assumed allelic frequencies (favorable/unfavorable) of 0.3/0.7, 0.5/0.5, and 0.8/0.2. A real beef cattle pedigree which included 29,101 animals was used to test selected methods using simulated genotypes with allelic frequencies of 0.3/0.7 and 0.5/0.5. For the simulated pedigrees, known and unknown allelic frequencies were assumed. The methods used included random sampling, selection of males, and selection of both sexes based on the diagonal element of the inverse of the relationship matrix (A-1) and absorption of either the A or A-1 matrix. For random sampling, scenarios included selection of 5 and 15% of the animals while all other methods presented concentrated on the selection of 5% of the animals for genotyping. The methods were evaluated based on the percentage of alleles correctly assigned after peeling (AKP), the probability of assigning true alleles (AKG) and the average probability of correctly assigning the true genotype (APTG). As expected random sampling was the least desirable method. The most desirable method in the simulated pedigrees was selecting both males and females based on their diagonal element of A-1. Increases in AKP and AKG ranged from 26.58 to 29.11% and 2.76 to 6.08%, respectively, when males and females (equal to 5% of all animals) were selected based on their diagonal element of A-1 compared with selecting 15% of the animals at random. In the case of a real beef cattle pedigree, selection of males only or males and females yielded similar results and both selection methods were superior to random selection.

Key Words: Genotype Sampling, Marker-Assisted Selection, Simulation

412 Effect of raw data normalisation on detection of differentially expressed genes in cDNA microarray experiments. C. Dimauro, N. P. P. Macciotta*, and A. Cappio-Borlino, *Dipartimento di Scienze Zootecniche, Università di Sassari*, *Sassari, Italia*.

cDNA microarrays allow for the monitoring of the expression of thousands genes in parallel in different tissues or conditions. However, the interpretation of microarray experiments requires large manipulation of raw fluorescence data that may seriously affect the reliability and repeatability of final results. Two data processing main steps can be identified: normalization, i.e. the pre-scaling of data to correct for technical biases; choice of a suitable statistical model to detect differentially expressed genes, controlling for false discovery rate. Whereas the impact of the latter has been widely investigated, the influence of normalization techniques has not been fulfilled to date. In this work, four different combinations of normalization techniques have been carried out on published fluorescence data generated in an experiment aimed at defining the temporal gene profiling of liver from periparturient dairy cows (GEO accession n.GSE2692). The normalizations were aimed at removing bad spots, correcting for background intensity (2 corrections), bias and dye effect. Differentially expressed genes were detected, for all combinations, with a gene-specific linear mixed model that included the fixed effect of treatment, and random effects of array and cow, plus the random residual. The range of differentially expressed genes ranged from about 2500 to 4000 among the different combinations, with a statistical significance threshold of 0.05, increasing dramatically to a range of about 300 to 500 when a Bonferroni corrected statistical test was applied. The percentage of genes commonly detected in the different combinations is between 20-50% and 2-8% for unadjusted and adjusted tests respectively. Moreover a great variation in the results can be still observed whether mean or median fluorescence intensity data was used. All these results highlight a relevant impact of normalization techniques on detection of differentially expressed genes in cDNA microarrays experiments and strongly suggest that consistent comparisons should be made by using the same normalization procedures.

Key Words: cDNA Microarrays, Normalisation, Differentially Expressed Genes

413 Methods to explain genomic estimates of breeding value. P. M. VanRaden and M. E. Tooker*, *Animal Improvement Programs Laboratory, USDA*, *Beltsville, MD*.

Genetic markers allow animal breeders to locate, estimate, and trace inheritance of many unknown genes that affect quantitative traits. Traditional models use pedigree data to compute expected proportions of genes identical by descent (assumed the same for all traits). Newer genomic models use thousands of marker genotypes to obtain actual fractions of DNA shared by any two individuals. Full sibs, for example, may actually share 45% or 55% of their DNA rather than the 50% expected in the traditional relationship matrix. The actual percentage of shared genes has a standard deviation (SD) equal to 50% divided by the square root of twice the number of independent loci affecting the trait. This SD does not decrease below 3.5% even with very large numbers of loci on 30 chromosome pairs because loci on the same chromosome are linked rather than independent. Accounting for these small differences in the relationship matrix and tracing individual genes can increase reliability, especially if the number of genotyped individuals is large. Reliability from parent average is <50% and is the upper limit for individuals without phenotypic data or progeny in traditional models. With genotypes and phenotypes for full sibs, genomic models can increase the reliability to 62% with 100 full sibs or 95% with 1000 full sibs. If no sibs have both genotypes and phenotypes but 100 full sibs of each parent do, reliability can increase to 57%. Less gain is provided from each distant relative, but the number of distant relatives may be very large. “Unrelated” individuals actually share many unknown common ancestors born prior to the known pedigree file and thus can provide additional information. More markers are required to estimate and trace genetic effects for distant rather than close relatives because the shared DNA segments are shorter. More markers are also required when more loci affect a trait. Another useful concept is the proportion of genes in common that affect a particular trait, called a quantitative trait loci (QTL) relationship matrix. Genetic evaluations should be more accurate if genomic relationships replace the traditional relationships computed from pedigrees.

Key Words: Relationship Matrix, QTL, Genomics

414 Efficient estimation of breeding values from dense genomic data. P. M. VanRaden*, *Animal Improvement Programs Laboratory, USDA*, *Beltsville, MD*.

Genomic, phenotypic, and pedigree data can be combined to produce estimated breeding values (EBV) with higher reliability. If coefficient

matrix Z includes genotypes for many loci and marker effects (u) are normally distributed with equal variance at each, estimation of u by mixed model equations or EBV by selection index equations that include a genomic relationship matrix (G) are equivalent models. Matrix G is analogous to traditional relationship matrix A and is obtained by subtracting allele frequencies from coefficients of Z and then dividing the revised Z Z' by the number of marker effects (m). Equations that include either Z'Z or Z Z' are dense and can be solved by several methods tested on simulated data. Off-diagonals count individuals that inherited two different alleles (in Z'Z) or alleles shared by two individuals (in Z Z'). Algorithms that estimate marker effects using Z'Z and then sum to obtain EBV are more efficient than those that use Z Z' unless m greatly exceeds the number of genotyped individuals (n). With direct inversion to obtain reliabilities, computing times increase by n^3 for EBV or m^3 for marker effects. With iteration to estimate u, computing times increase with the number of iterations (i) times m^2. The algorithm known as iteration on data reduces memory, and a simple trick can increase speed. For each individual, its genotypes (left-hand sides) are multiplied by previous round estimates and this sum minus the diagonal coefficient is used to adjust right-hand sides instead of summing off-diagonals times previous solutions again for each effect. Computing time is linear with number of effects in the model (not quadratic as in many previous algorithms) and linear with total number of genotypes, increasing with i times n times m. More iterations and under-relaxation were required for convergence as m increased. The methods include only phenotypes (or daughter deviations) for genotyped individuals, but future algorithms ideally should also include phenotypes of un-genotyped individuals, perhaps by absorbing equations for marker effects into equations for EBV.

Key Words: Iteration on Data, Genetic Markers, Algorithm

415 Recursive algorithm to compute inbreeding coefficients assuming non-zero inbreeding of unknown parents. I. Aguilar* and I. Misztal, *University of Georgia*, *Athens*.

The objectives of this study were to investigate a recursive algorithm to calculate inbreeding coefficients using rules from the tabular method and to expand it to consider animals with missing parent information using VanRaden's method. For each animal x present in the pedigree, the inbreeding coefficient F_x is calculated as $0.5R_{sd}$, where R_{sd} is the numerator relationship between sire and dam of the animal x. Computation of R_{sd} is recursive and involves tracing the ancestors. Three cases are considered. In the first case, if $x=0$ or $y=0$, $R_{xy}=0$. In the second case, if $x=y$, $R_{xy}=1+F_x$. Finally, $R_{xy}=0.5(R_{sy}+R_{dy})$, being x younger than y; and s,d sire and dam of x. The modification was done in the first case, where $x=0$ or $y=0$ denote unknown parents. Let a negative code denote the year of birth of their progeny, and b_i be an average inbreeding of all animals born in year i. Then $R_{xy}=2b_i$, where b_i is based on x and y code: if $x<0$ and $y>0$, $b_i=b_{-x}$; if $x>0$ and $y<0$, $b_i=b_{-y}$; and if $x<0$ and $y<0$, $b_i=max(b_{-x},b_{-y})$. The algorithm is iterative, in the first round b_i is zero, and in the others b_i is the average of inbreeding of animals with year of birth i, considering only the inbreeding coefficient of animals with known parents. Testing involved 17 million US Holsteins. Solutions were compared with two algorithms. Convergence was reached in 6 rounds. The computing time per round was 4 minutes, 2 times lower than the implementation of VanRaden algorithm based on tabular method, and two times higher than the algorithm by Meuwissen and Luo, which assumes zero inbreeding of unknown parents. The presented algorithm can also be used for other purposes, including computing of relationship of groups of animals (e.g., sires) using the full pedigree, or creation of nonadditive relationships.

Key Words: Inbreeding Coefficient, Unknown Parent, Recursive Algorithm

416 A social competitive model with the categorical expression. I. Misztal and R. Rekaya*, *University of Georgia*, *Athens*.

A model by Muir and Schinckel used to model social competition among animals assumes that the animal competitive effects are expressed on a continuous scale. This may not be realistic and could lead to theoretical problems such as variance inflation. A model is proposed where these effects could be expressed in a few discrete categories (strongly dominant, .., independent,.., passive) or as binary (dominant, passive). Let y_{ij} be a record generated under a set of environmental effects i, and let d_j and c_j be the direct and competitive effects of animal j, respectively. Further, let $\alpha(k,x_i)$ be the effect of animal with dominance status k on its mates in the same pen in a set of environmental effects represented by x_i. Let p_j be a social dominance category of animal j. The model could be represented as:

$$y_{ij}= other + d_j+ \Sigma\, \alpha(p_k,x_i) +e_{ijk}$$

where *other* are effects other than animals, and the summation are over all the remaining animals in the pen. If only two categories are considered, the model simplifies to:

$$y_{ijk}= other +d_j-\alpha(1,x_i)q_j +e_{ijk}$$

where q_j is 1 if animal j is dominant, and 0 otherwise. Additionally, the dominance category of an animal can be described through a liability model:

$$l_{ij}= other +c_j+e_{ij}$$

where l_{ijk}, is an unobserved liability. Assignment of liabilities to categories can involve either fixed or variable thresholds. Thresholds that are independent of pen effect can result in multiple occurrences of "dominant" animals per pen. If there is only one dominant animal per pen, thresholds need to be adjusted for every pen to result in the desired decomposition of categories. If the dominance status of all animals is known, implementation of the proposed models can be achieved through a modified linear-threshold model. If the dominance status is not known, an additional step is needed where the dominance status is inferred using the observed data via a Bayesian MCMC approach. The social dominance model that assumes a categorical expression can allow for a more realistic expression of social dominance for animals housed in pens.

Key Words: Social Dominance, Competition

417 Comparison of two methods for computing approximated accuracies for growth traits in random regression models. J. P. Sanchez*[1,2], I. Misztal[1], and J. K. Bertrand[1], [1]*University of Georgia*, *Athens*, [2]*University of Leon*, *Leon, Spain*.

The random regression model (RR) fitted direct genetic and permanent environmental effects, maternal genetic and maternal environmental effects, and the residual variance, all using linear splines. Knots were set at 1, 205 and 365 d. Approximate accuracies were obtained by a method specifically designed for RR by Tier and Meyer (2004) (M1),

and by a method developed for multiple-trait models by Strabel and Misztal (2001) (accf90 program; M2). In both methods the only fixed effect considered was the contemporary group (CG). D1 was a simulated data set containing 30,250 animals, 5,000(250) base dams(sires) and 5 generations (G) of 5,000 animals, 3 measurements (M) per animal, distributed in 15 CG (GxM combination). The sex rate in non base animals was 1 M:4 F. D2 was a data set of 1,812,871 records of Gelbvieh animals in 199,168 CG. Initial analyses involved D1, where the exact accuracies were also computed by inversion (M3). Regression coefficient, intercept and R2 of direct accuracies when M1 was regressed on M3 at 205 days (Weaning Weight) for males were 0.95, 0.03 and 0.99. The same quantities of M2 on M3 were 0.96, 0.04 and 0.99, and of M1 on M2 were 0.98, 0.00 and 0.98. The corresponding numbers for females were 1.06, -0.01, 0.99 (M1 on M3), 1.09, 0.00, 0.99 (M2 on M3), and 0.98, 0.00, 1.00 (M1 on M2). For maternal effects both methods showed similar performance and errors. Both M1 and M2 overestimated accuracies for base dams with many offspring. Using data set D2 without distinction of sex and retaining only animals with computed accuracy >= .6 for M1, similar statistics for M1 on M2 were 1.05, -0.06, 0.97 (1.13, -0.14, .96) for direct (maternal) effects. Computing requirements for D2 were 8 CPU min. and 878 Mb. of RAM with M1 and 7 min. and 326 Mb. with M2. A multiple trait accuracy algorithm is useful for computing accuracy of a RR linear spline model when there is at most one observation per trait and no interest on other ages than those defining traits.

Key Words: Accuracy, Beef Cattle, Linear Splines

418 Equivalent mixed model equations for genomic selection. D. J. Garrick*, *Colorado State University*, *Fort Collins*.

Henderson's mixed model equations are used for genetic evaluation from pedigree and performance information. Equations are solved for factors influencing a trait (eg direct genetic, maternal genetic, maternal permanent environment). Assumptions to obtain BLUP include the var-cov matrix between effects on one animal (eg G0) and the var-cov matrix of additive effects between animals (numerator relationship or A matrix). These var-cov matrices are commonly full rank, and their inverses are used in computations. Widespread implementation has occurred because A-1 is sparse and can be easily made directly from pedigrees. Genetic merit is assumed to result from an infinitesimal number of genes of small effects. An incidence matrix is used to relate genetic merit to phenotypes. This indicator matrix contains one or more unit elements that identify the animals own additive and any other effects. The number of equations increases each evaluation, in proportion to the number of new animals. Genomics has delivered an apparently very different approach to selection. Genetic merit can be considered the finite sum of perhaps tens of thousands of effects, physically located at some place on the genome whose transmission can be traced through genetic markers or haplotypes. Genomic selection might involve mixed model equations that ignore animal effects but include haplotype effects. Pedigree relationships are not necessarily required, the dense markers being used to trace identity by descent (IBD) at each locus and these IBD probabilities being used to construct incidence matrices. Such equations would not increase according to the number of new animals added over time, only the number of new markers or haplotypes. Total genomic merit of candidates would be obtained by summing up many relevant haplotype effects.

An equivalent model can be written that does not explicitly fit haplotype effects but total genomic effects for each animal. This demonstrates the similarity between total genomic selection and conventional A matrix evaluation. The animal-based formulation may be computationally attractive in the short-term when there are more haplotype effects than animals with markers.

Key Words: Genetic Evaluation, Equivalent Models

419 Detection and use of single gene effects in large animal populations. N. Gengler*[1,2], S. Abras[1], M. Szydlowski[1], and R. Renaville[1], [1]*Gembloux Agricultural University*, *Gembloux, Belgium*, [2]*National Fund for Scientific Research*, *Brussels, Belgium*.

Unbiased estimation of single gene effects can only be achieved by estimating them simultaneously with other environmental and polygenic effects in mixed inheritance models. As in large animal populations the vast majority of animals are however not genotyped, missing genotypes have to be estimated. Currently used methods as iterative peeling or MCMC are unpractical for large datasets. Recently an alternative method to estimate missing gene content, defined as the number of copies of a particular allele was developed. Unknown gene content is approximated from known genotypes based on the additive relationships between animals. In this study the proposed method was tested for the detection of candidate gene effects for bovine transmembrane GHR on first lactation milk, fat and protein test-day yields in Holsteins. The GHR gene was estimated to show moderate to small gene substitution effects of 295 g/day for milk, -8.14 g/day for fat yield and -1.83 g/day for protein yield for a phenylalanine replacement by a tyrosine (frequency 23.3%). Only 961 mostly recent sires out of 2,755,041 animals were genotyped. The accuracy of the procedure was then estimated by doing 15 simulations using gene dropping and adjustment of the observed 12,858,741 records using the estimated parameters. The new method to estimate missing gene content resulted to be functional and accurate as relative bias in the estimation of allele frequency was very low (0.2%) as were the biases for moderate allele substitution effects (milk: 3.7%; fat yield: 3.3%). Biases were larger for traits with smaller substitution effects (protein yield: 55.3%). The new method has the potential to allow even in very large animal population with few genotyped animals reliable estimation and use of moderate to large single gene effects.

Key Words: Single Gene Effects, Large Population, Estimation of Gene Content

Breeding and Genetics - Livestock and Poultry: New Challenges and Opportunities From Automation of Animal Data Recording

420 Current and near term technologies for automated recording of animal data for precision dairy farming. G. Katz*[1], A. Arazi[1], N. Pinsky[1], I. Halachmi[2], Z. Schmilovitz[2], E. Aizinbud[1,2], and E. Maltz[2], [1]*SAE Afimilk*, *Kibbutz Afikim, Israel*, [2]*Institute of Agricultural Engineering, Agricultural Research Organization - The Volcani Center*, *Bet Dagan, Israel*.

Data monitoring in the modern dairy farm enables the ongoing control of production, animal health and welfare. It is used for management planning, early disease diagnosis control and retrospective analysis of performance from single cow to herd. Currently most data is extracted manually, yet manual observation is gradually being replaced in many milking systems by automated recording(milk yield, milk conductivity, activity recording and body weight measurements) leading to better data, both in quantity and quality. Two new additional sensors are introduced: a milk analyzer and a behavior meter both are already installed and used in several commercial and research farms. The first gives real time measurements of milk solid concentrations and indicates the presence of blood and the level of somatic cells in the milk. The behavior meter continuously records the laying time, laying bouts and the activity of the individual cows. These additional sensors open new horizons. Herd genetics may be improved by selection based on frequent milk solids determination in individual cows in herds where milk is not tested regularly. Automated daily determination of fat corrected milk and body weight enables the prediction of dry matter intake for better use of computer controlled self feeders and asses the required rest periods for individual lactating cows. Daily solids determination alerts to any sudden changes in fat and protein content of the milk, of individual cows, groups or the whole, ensuring its economic value. Early diagnosis of sub acute ruminal acidosis and ketosis by using milk fat concentration, fat to protein ratio and weight changes in both individual and groups of cows, allows for better prevention policy and prompt treatment. The cow-behavior enables animal welfare assessment in different environmental conditions and stress situations, as well as reproductive and health status. These new sensors, in addition to the present ones (which record milk yield, milk flow rate, milk electric conductivity and daily body weight) will therefore improve individual cow health, overall herd performance and management decision making.

421 Thriving in a declining market – the new service paradigm for DHI's. N. Petreny*, *CanWest Dairy Herd Improvement*, *Guelph, Ontario, Canada*.

Exponential growth of computing capabilities and the development of advanced analytical instrumentation now offer ability to transfer traditionally centralized functions to the individual farm level – including record processing and milk analysis. The resulting challenge for the broader industry is the loss of data that supports traditional herd improvement and genetic evaluation activities as isolated data islands are created within the industry. Handling of independent data streams will become more complex and the underlying elements of data collection will become increasingly variable. Without evolution, the slow death of traditional dairy herd improvement (DHI) activities shall occur as organizations operate using historic service guidelines designed for the wrong customer, fail to innovate and adopt technology applications at a rate significantly slower than the dairy farm customers they service (in-voluntary obsolescence). Herd improvement organizations must shift their primary focus to supporting dairy herd profitability and not act as data collectors for genetic evaluation and breed improvement activities – both of which should be a by-product of the core DHI services. Technologies must be harnessed to enhance the profitability of customers by personalizing services and extracting more information from data and milk samples. Current Information technologies will now accommodate active benchmarking and individual farm adjustment factors. New analytical technologies allow for cost effective health and disease diagnostics from the millions of milk samples currently collected. Innovation requires continuous planning, research and investment. Businesses not reinvesting in infrastructure have a limited future as assets near the end of their life without a replacement plan. Dairy is no exception. Efforts to retain traditional agencies with a withering client base by operating a skeleton service will not last. The DHI sector needs to ensure that partnerships, economies of scale and innovation are implemented at the organizations level at a speed at least equal to the farm adoption rate.

Key Words: DHI, Technology, Innovation

422 Harnessing automatic data collection to enhance genetic improvement programs. G. R. Wiggans*[1], M. A. Faust[2], and F. Miglior[3,4], [1]*Agricultural Research Service, USDA*, *Beltsville, MD*, [2]*ABS Global, Inc.*, *Deforest, WI*, [3]*Agriculture and Agri-Food Canada*, *Sherbrooke, QC, Canada*, [4]*Canadian Dairy Network*, *Guelph, ON, Canada*.

Automatic data collection can improve data accuracy, reduce cost of obtaining data, and enable addition of other traits. In the United States, genetic improvement programs for dairy cattle have benefited from a long history of innovation related to data collection and processing: computerization in the 1950s, establishment of laboratories for component testing in the 1960s, electronic transfer of data from farms and laboratories in the 1980s, on-farm data entry in the 1990s, and the recent use of hand-held devices. The recent evolution of increasing emphasis on fitness relative to yield is likely to be hastened because of automated data collection. Electronic milk meters currently are used for 7% of DHI cows and can provide data on total yield, milking speed, and milk conductivity. Other sensors may be added to detect progesterone levels, milk temperature, and information on component concentration. The expected widespread adoption of radio-frequency identification will facilitate electronic collection of data by improving the reliability of identification determination. Electronic scales may be justified as a way to determine body condition score automatically. Hand-held computers may facilitate collection of health data and increase uniformity across herds. Weather data may be used to account for environmental effects better. As the number of traits increases, herds that can supply more data will become increasingly important. A separate progeny-test category may be developed for farms that collect all data electronically and have those data monitored closely. Owners could be paid for their data on a quality basis, thus adding a source of revenue. Such herds could also have parentage verification to improve accuracy further. Automated data collection along with parentage verification offers substantial opportunities for genetic improvement of overall economic merit.

Key Words: Automatic Data Collection, Genetic Improvement, Fitness Traits

423 Optimal number of replications for the Meullenet-Owens-Razor-Shear (MORS) and tenderness variations between right and left broiler breast fillets. Y. S. Lee*, A Saha, C. M. Owens, and J. F. Meullenet, *University of Arkansas*.

MORS is a relatively new method for measuring poultry meat tenderness which is less time-consuming than the Warner-Bratzler and Allo-Kramer shear and shown to be equivalent in performance. However, the number of measurements for MORS to provide a reliable estimate of the tenderness of an experimental unit has not been investigated. There is also limited information available on the variation in tenderness between right and left fillets from a single carcass. The objectives were (1) to determine the number of recommended measurements to be taken on a fillet using MORS and (2) to examine differences in tenderness between the two halves of a fillet. Sixty birds were deboned at either 1.75 or 6 h postmortem (PM). Eight shears were taken on each cooked fillet at predetermined locations and the shear energy (MORSE) calculated in N.mm. The average from 8 measurements per fillet was considered to yield a representative estimated tenderness for the experimental unit (fillet half) and averages of 2 to 8 measurements were considered as potentials for a recommended number of shears. The appropriate number of replications was determined by simple regression using the average of 8 measurements as Y and the average of 2, 3, 4, 5, 6 or 7 as X. A composite hypothesis testing a slope of 1 and an intercept of 0 was then tested. The hypothesis (H0: intercept=0 and slope=1) for number of shears of 2, 3 and 4 was rejected implying that mean MORSE were in these cases not equivalent to mean MORSE for 8 shears. Averages of 5, 6 or 7 measurements did not significantly differ from 8 measurements. For 5 shears, the average error rate was found to be 0.78%. The overall correlation between left and right MORSE was found to only be 0.70. Overall correlations were better for fillets deboned after 6 hrs of aging. The recommended number of shears to be performed on pectoralis major muscles is 5 but error rates could be further reduced with 6 shears. This study also does not seem to indicate that left and right fillets are completely identical in tenderness especially for short aging durations.

Key Words: MORS, Tenderness, Broiler Breast Fillet

424 Carbon monoxide in MAP chicken breast fillets and drums as a food safety intervention to reduce pathogen loads and extend shelf-life. A. M. Lopez*[1], G. Poullier[2], A. M. Luna[1], C. Z. Alvarado[1], L. D. Thompson[1], M. M. Brashears[1], and J. C. Brooks[1], [1]*Texas Tech University*, *Lubbock*, [2]*Toulouse University*, *Toulouse, France*.

The Food and Drug Administration (2002) approved carbon monoxide (CO at 0.4%) as a component of a gas mixture in a modified atmosphere packaging (MAP) systems to maintain wholesomeness, provide flexibility in distribution and reduce shrinkage in meat; however little research has been done in poultry. This project evaluated the effect of MAP with CO on the growth of pathogens and quality parameters in poultry products, and its effectiveness as a possible food-safety intervention. Three replications of 144 samples each were conducted with skin-on drums and skin-off breasts fillets. The samples were either used as controls or inoculated with 1 × 104 cfu/g of a 3-strain Salmonella cocktail. Samples were stored at (4°C) in one of four packaging types: control (PVC overwrap); 0.4% carbon monoxide / 30.0% carbon dioxide / 69.6% nitrogen,;30% CO2 / 70% N2; or vacuum for 0, 3, 7, 14, 18, 21 days. Analyses included Salmonella enumeration, color (L*,a*,b*),TBARS, odor, Psychrotroph counts, aerobic plate counts (APC), coliforms, and generic E. coli. There were no differences in Salmonella growth or TBARS over time within treatments. However, psychrotrophs, coliforms, APC, and generic E. coli, were significantly lower in the MAP packages compared to control packages. Fresh color and odor were retained in the CO-packaged breasts and drums when compared to the other treatments. Therefore, some components of shelf-life of breast fillets and drums can be extended with MAP and CO MAP.

Key Words: Carbon Monoxide, Chicken Breasts, Salmonella

425 Quality of shell eggs stored under modified atmosphere packaging using gas mixtures containing CO and CO_2. D. Aggarwal*, C. Alvarado, C. Brooks, D. Wester, A. Tittor, A. M. Luna, and L. Thompson, *Texas Tech University*, *Lubbock*.

The effect of three types of modified atmosphere packaging (MAP) on the quality attributes of oiled fresh USDA Grade AA shell eggs during of storage was investigated. Shell eggs were subjected to one of four packaging treatments: (1) control - air; (2) 20% CO_2/0.4% CO/79.6% N_2; (3) 20% CO_2/80% O_2; and (4) 20% CO_2/80% N_2. Eggs were stored for up to 30 days in a retail case at a temperature of 6 ± 10°C (refrigerated) or on shelves at 21 ± 10°C (abusive). Eggs were packaged 8 to a tray with a tray considered as the experimental unit. Two trays per treatment per temperature per day were prepared in each trial with a total of three trials being conducted. Packages were opened and sampled on days (D) 1, 7, 14, 21, and 30 for determination of pH (yolk, albumen, whole egg), color (L^*, a^*, b^*), TBARS, foam capacity and stability, Haugh units, and yolk index (YI). Data were analyzed by ANOVA in a 2 (temperature) × 4 (packaging treatment) × 5 (time-points) factorial design using programs in SAS. Where appropriate, means were separated by LSMeans. Whole egg pH was lower throughout storage at both temperatures for the three MAP treatments ($P < 0.0001$). Albumen pH for MAP treatments was significantly lower regardless of temperature as compared to the controls ($P < 0.0001$). At 21°C, there was a significant decline in yolk index of the control eggs during storage compared to the eggs from the three MAP treatments (D1: control YI = 0.36 vs MAP average YI = 0.39, $P > 0.05$; D30: control YI = 0.25 vs D30 MAP average YI = 0.40, $P < 0.0001$). MAP treatment was effective at 21°C in maintaining Haugh units during storage compared to the control packaging. MAP was effective in reducing egg deterioration and loss of functional quality during storage at refrigerated and abusive storage temperatures.

Key Words: Shell Eggs, MAP Packaging, Yolk Index

426 Optimizing NaCl marinade concentrations to improve meat tenderness, flavor, and juiciness of early deboned broiler breast fillets. C. M. Owens, S. C. Purcell*, A. Saha, and J. F. Meullenet, *University of Arkansas*, *Fayetteville*.

Previous studies show that marination of broiler breast meat improves meat quality attributes and yield. Marinades typically contain salt and phosphates; however, due to increased health awareness, trends for lower salt content have increased. The purpose of this study was to evaluate the effect of various salt concentrations on early-deboned boneless breast fillet tenderness and juiciness. One hundred fifty broilers, six-weeks of age, were processed via automated line, chilled in a two-stage process, and deboned at 2 h postmortem. Test fillets were vacuum tumbled for 30 min with a 15% marinade containing phosphate (0.45%) and salt (NaCl) concentrations of 0.33, 0.50, 0.75, or 1.0 %. Control samples were neither tumbled, nor marinated. Cooked fillets were subjected to instrumental analysis using the MORS method (total energy; TE) and consumer sensory analysis using hedonic and Just About Right scales to assess texture, intensity of tenderness, saltiness and juiciness. Tenderness of breast fillets was highly correlated to salt concentration; TE decreased with increasing salt concentration indicating improved tenderness due to marination. Salt concentrations of 0.5% or more resulted in a significant decrease in TE compared to control. According to the consumer panel, a minimum of 0.33% salt was needed to improve texture/tenderness; values further improved as salt concentration increased. Less than 16% of consumers considered marinated fillets as ″too tough″ compared to 49% who considered the control fillets ″too tough″. The attribute, ″saltiness,″ increased as the levels of salt concentration increased, but even at the highest level (1%), only 14% of consumers considered fillets ″too salty″. When compared to the control, marinating with any level of salt improved juiciness. However, marinating with less than 1%, many consumers (31-41%) considered the cooked products ″too dry″. These results suggest that marination of early deboned breast fillets, even with low salt concentrations, can improve tenderness; however, marinating with lower levels of salt may lead to a less juicy product.

Key Words: Marination, Salt, Tenderness

427 Alpha, gamma, and acetate tocopherol determination in chicken muscle by HPLC. C. Narciso-Gaytán*, D. K. Shin, C. A Bailey, A. V. Haq, A. R. Sams, and M. X. Sánchez-Plata, *Texas A&M University*, *College Station*.

The amount, type and activity of vitamin E isomers in chicken muscle influence the lipid and nutritional stability of the meat. The objective of the present study was to estimate the presence and quantify the deposition of alpha and gamma tocopherol, and tocopherol acetate in breast and thigh muscles, affected by dietary fat/oil source and supplemented level of vitamin E. Six hundred Cobb × Ross broilers were fed for 6 weeks with a basal corn-soybean meal diet including soybean, palm kernel or animal/vegetable oil, each supplemented with 33 or 200 mg/Kg of dl-α-tocopheryl acetate. Broilers were randomly assigned into 6 treatments and 4 repetitions, with 25 birds each. After slaughtering of broilers, breast and thigh muscle samples were collected, vacuum-packed and kept frozen at -20°C for further analysis. A 1.0 g muscle sample was mixed with 250 mg ascorbic acid and 7.3 ml of KOH solution (11% in ethanol:water: 55:45) with subsequent incubation for 20 min in a 70°C water bath, hexane was used to separate the tocopherol isomers from the mixture. Tocopherols were extracted by reverse phase (mobile phase: methanol:n-propanol:water 78:17:5) and quantified by photo diode detection (210 and 295 nm wavelength). Efficiency recovery was determined by adding 8 µg of gamma tocopherol. Tocopherol acetate was detected only at 210 nm, while alpha and gamma tocopherols were observed in both 210 and 295 nm. The results showed no interactions in either tocopherol isoform with respect to dietary fat, vitamin E or muscle type. Dietary supplementation of vitamin E increased the deposition of alpha, and acetate, but gamma tocopherol. All tocopherol isoforms were significantly higher in thigh, than breast muscle ($P<0.05$). In conclusion, dietary supplementation of vitamin E increases alpha tocopherol and tocopherol acetate in breast and thigh chicken muscles.

Key Words: Vitamin E, Chicken Muscle, HPLC

428 Fatty acid composition of the gestation and lactation diet affects the fatty acid composition of the backfat of the progeny. G. Bee*, *Agroscope Liebefeld-Posieux, Research Station (ALP)*, *Posieux, Switzerland*.

The aim of the study was to determine the effect of 2 dietary fats (coconut fat [**CF**] and soy oil [**SO**]), which differs in their SFA, MUFA, and PUFA content, supplemented to the gestation and lactation diet of 16 multiparous Swiss Large White sows on the fatty acid (**FA**) composition of the backfat of their progeny at 105 kg BW. At weaning 4 gilts from each CF and SO sow were selected and fed a standard starter and grower diet from 9 to 63 kg BW. In the finishing period (66 to 105 kg BW) 2 gilts were fed a finisher diet (**A**) with the same FA composition (expressed as % total FA; SFA: 25.8; MUFA: 26.6; PUFA: 47.6) as the growing diet, whereas 2 littermates were fed a more saturated finishing diet (**B**; SFA: 28.8%; MUFA: 25.1%; PUFA: 46.1%). Growth performance, carcass characteristics, and the FA composition of the backfat was assessed. Regardless of the diet fed in the finishing period, progeny from CF sows grew slower (0.65 vs. 0.68 g/d; $P = 0.08$) and were less efficient (0.38 vs. 0.39 kg/kg; $P = 0.06$) than gilts from SO sows. Gilts in treatment B had lower carcass yield (82.0 vs. 81.4%; $P = 0.02$), higher percentage lean meat (59.3 vs. 58.5%; $P = 0.09$), lower percentage backfat (11.2 vs. 11.7%; $P = 0.08$), lighter hearts (408 vs. 428 g; $P = 0.05$) and kidneys (285 vs. 300 g; $P = 0.05$) and heavier livers (1551 vs. 1483 g; $P = 0.02$) compared to A gilts. The backfat of gilts in treatment B had higher ($P < 0.01$) SFA (40.2 vs. 39.3%) and MUFA (42.6 vs. 41.1%) and lower PUFA (17.2 vs. 19.7%) concentrations than the backfat of A gilts. These differences were primarily due to higher levels of stearic (23.5 vs. 22.9%), palmitoleic (2.0 vs. 1.8%), oleic (39.3 vs. 38.1%), and lower linoleic acid (14.6 vs. 17.1%) levels ($P < 0.01$ for each). Feeding the more saturated finisher diet decreased the PUFA content to a greater extent in the backfat of gilts born from CF (16.6%) than SO (17.7%) sows (maternal feeding × finisher diet interaction; $P = 0.04$). These findings revealed that not only the FA composition of the growing finisher diet but also the FA of the maternal diet affects the FA composition of the backfat of slaughter pigs.

Key Words: Dietary Fat, Maternal Nutrition, Pig

429 Comparison of vitelline membrane strength amongst breeds of commercial layers. D. R. Jones[1] and K. E. Anderson*[2], [1]*USDA, Agricultural Research Service, Egg Safety and Quality Research Unit*, *Athens, GA*, [2]*Department of Poultry Science, North Carolina State University*, *Raleigh*.

The strength and elasticity of the vitelline membrane is important for both food safety and product quality concerns. The strength of the

membrane has been associated with the ability of microorganisms to enter the nutrient rich yolk. Also, contamination of commercially prepared albumen with yolk during separation can lead to greatly diminished albumen functionality. A study was conducted to determine the strength and elasticity of the vitelline membrane of eggs from six strains of commercial laying hens (3 white, 3 brown). Two different probes were utilized to assess the membrane: 75 mm disc (2.0 g trigger force) and 1 mm, rounded end probe (0.2 g trigger force). Eggs were collected on three consecutive days from layers which were part of the North Carolina Layer Management and Performance Test. All eggs were stored at 4C until tested 5 d after lay. A TA.XTplus Texture Analyzer with a 750g load cell and test speed of 1mm/s was utilized for all measurements. Twelve eggs from each strain were tested daily for each probe. Force measurements for the disc ranged from 132.43 – 173.08 g ($P < 0.05$) with elasticities of 8.25 – 9.49 mm ($P < 0.01$). The 1 mm probe recorded average force measurements of 2.26 – 2.60 g ($P < 0.01$) and elasticities of 2.87 – 6.78 mm. Both probes identified the same strain of layers as producing eggs with the lowest vitelline membrane strength and the least elastic membrane. Force measurements recorded by the disc were much greater and were more closely associated with the linear detection region of the load cell. The disc probe allowed for a more complete assessment of membrane strength than the 1 mm probe due to the high percentage of the membrane having the force exerted upon it. The 1 mm probe could provide insight into the strength at a single point on the membrane where bacteria could attack. The choice of testing probe can have a direct effect on the outcome of the results and should be based on the precise quality concern being targeted.

Key Words: Shell Egg, Vitelline Membrane Strength, Yolk Quality

430 Postmortem sarcomere length characterization between *Psoas major* and *Longissimus dorsi* muscles in cattle. I. Zapata*[1], M. Yamaguchi[1], J. Wakamatsu[2], A. Hattori[2], and M. Wick[1], [1]*The Ohio State University*, *Columbus*, [2]*Hokkaido University*, *Sapporo, Japan*.

Understanding the biological mechanisms of postmortem events in muscle is of enormous importance for the meat industry due to its relation with quality. Although studies have attempted to relate sarcomere length to tenderness, there is a paucity of research on their postmortem characterization between the *Psoas major* (PM) and *Longissimus dorsi* (LD). The aim of this study was to characterize the postmortem sarcomere length of PM and LD muscles in cattle. Samples from the PM and LD muscles were removed from 32 animals at 45 min postmortem at the abattoir in the Ohio State University meat science laboratory. Muscle tissue free of evident fat or connective tissue was dissected from each sample and fixed in a glutaraldehyde/cacodylic acid buffer pH 7.1. Samples were homogenized in cacodylic acid buffer pH 7.1, mounted on glass slides and sealed. Slides were observed by phase contrast microscopy and images were captured with a CCD camera. Sarcomere lengths were measured using image analysis software. Statistical analysis of the sarcomere length was performed using the MIXED procedure from SAS. Representative samples from both muscles were postfixed with osmium tetraoxide and embedded in Eponate resin. Thin sections were obtained and mounted on copper grids, stained with uranyl acetate and lead citrate. Grids were observed using transmission electron microscopy (TEM) and images were taken. Phase contrast based sarcomere lengths of the PM and LD were significantly different ($P < 0.001$). Least square mean estimated lengths were 1.897 ± 0.067 µm for LD and 2.461 ± 0.067 µm for PM. Measured lengths of TEM images were consistent with the measured lengths from phase contrast microscopy. These data demonstrate clear differences in the postmortem architecture between the two muscles. Although tenderness values were not measured in this study, these results indicate that the difference in tenderness generally accepted to exist between the filet mignon (PM) and the ribeye (LD) may be related to the differences in initial sarcomere lengths.

Key Words: Microscopy, Postmortem, Sarcomere Length

431 Cholesterol quantification in meat and meat products. T. T. N. Dinh*[1], L. D. Thompson[1], J. C. Brooks[1], M. F. Miller[1], and J. R. Blanton, Jr.[2], [1]*Texas Tech University*, *Lubbock*, [2]*Intervet Inc.*, *Millsboro, DE*.

The objectives of this study were to develop an accurate and precise method for cholesterol quantification in meat samples based on modifications to an existing procedure (AOAC Official Method 994.10), and to apply this method to evaluate the differences in cholesterol content of longissimus muscles (LM) from Angus (AN, n = 5), Brahman (BR, n = 4), and Romosinuano (RM, n = 9) breeds. Validation of this method was performed using a meat homogenate (Standard Reference Material 1546) from National Institute of Standards and Technology (NIST), and LM samples from the three breeds with fat contents ranging from 2.4% to 9.3%. The results indicated that the modified method was efficient and accurate with cholesterol recovery exceeding 95%. The method was also found to be repeatable with an average coefficient of variation of 3.12%. The modification reduced 90% of chemicals used and eliminated time-consuming steps that hindered high throughput application of the traditional method. Application of this method for cholesterol quantification of LM samples revealed differences among the three breeds evaluated. The Angus LM with a higher fat content (50% higher than BR and RM) was associated with significantly higher cholesterol concentrations (70.25 mg/100 g) compared to Brahman and Romosinuano purebreds (64.77 mg/100g and 65.76 mg/100g; $P = 0.005$ and $P = 0.006$; respectively). Cholesterol concentration was found to be related to fatness of LM muscle from the three breeds ($r = 0.90$, $P < 0.001$). Cholesterol concentrations found in LM were slightly higher than those reported in the USDA National Nutrient Database for Standard Reference for separated lean of Choice rib-eye. This modified method was reliable and should be evaluated for adoption as an appropriate method for cholesterol quantification in meat samples.

Key Words: Cholesterol Quantification, Gas Chromatography, Beef Longissimus Muscle

432 Round muscle profiling of tenderness and postmortem proteolysis. M. J. Anderson*, S. M. Lonergan, and E. Huff-Lonergan, *Iowa State University*, *Ames*.

Definition of characteristics of individual muscles from the round will make it possible to consistently add value to individual cuts.

Therefore, the objective of this study was to determine the biochemistry underlying the differences in tenderness of specific muscles of the round. Ten beef cattle were slaughtered and the longissimus dorsi (LD) and the round muscles gracillus (GR), adductor (AD), sartorius (SAR), vastus lateralis (VL), and vastus intermedius (VI) were removed. Samples were aged 1, 3, 7, or 14 d. Objective tenderness measurements (star probe) and western blots for troponin-T to determine protein degradation were preformed. For troponin-T degradation, two bands (Upper intact band, UI; 30kDa degradation product band, 30kDa) were measured and compared to a reference. On d 1 star probe analysis found that VL required more force to penetrate ($P=0.04$) than VI, SAR, and GR. VI had a lower force ($P=0.04$) than LD. UI band of VI was less intense ($P<0.01$) than AD, GR, and LD. LD had a more intense ($P<0.01$) UI band than all other muscles except the AD. 30kDa was less intense ($P=0.016$) than GR, LD, and VI. On d 3 VL required more force ($P<0.01$) than all other muscles except the AD. AD required more force than GR, SAR, and VI and LD required more force than GR. UI band was less intense ($P<0.01$) for VI than LD, AD, and GR. The UI band from LD was more intense ($P<0.01$) than all other muscles except AD. 30kDa band of AD and LD were more intense ($P<0.01$) than all other muscles with the exception that LD tended to be more intense ($P=0.069$) than VL. On d 7 LD, AD, and VL all required more force ($P<0.01$) than GR, SAR, and VI. 30kDa band of LD was more intense ($P<0.01$) than all other muscles. On d 14 VL required more force ($P<0.01$) than all other muscles except AD, and AD required more force ($P<0.01$) than GR, SAR, and VI. 30kDa band of LD was more intense ($P<0.01$) than all other muscles. 30Kda band of AD was more intense ($P<0.01$) than SAR and VI, and VI was less intense ($P<0.01$) than VL. These data show that physical and biochemical differences exist between individual muscles of the round and may provide insight on ways to add value to individual cuts.

Key Words: Troponin-T, Tenderness, Beef

433 MSTN regulates IGF-2 but not IGF-1 expression during myogenesis of cattle. M. Miyake*, S. Hayashi, Y. Imai, K. Watanabe, S. Ohwada, H. Aso, and T. Yamaguchi, *Tohoku University*, *Sendai, Japan*.

Myostatin (MSTN) is a member of TGF-β superfamily that negatively regulates skeletal muscle mass. Conversely, insulin-like growth factor (IGF)-1 and IGF-2 are essential for the development, regeneration and hypertrophy of skeletal muscle. Although it seems that MSTN and IGF cooperate on skeletal muscle development, their mutual relationship still remains unclear. The present study was carried out to investigate the effects of MSTN on the IGF-1 and IGF-2 expression in Japanese shorthorn cattle. We first examined the IGF-1 and IGF-2 expression in the normal and regenerating the *M. longissimus thoracis* of normal-muscled (NM) and double-muscled (DM) cattle and next the effects of MSTN on the IGF-1 and IGF-2 expression in primary myoblast cultures derived from the *M. longissimus thoracis* of NM and DM cattle. The mRNA expression of IGF-2 was higher in the *M. longissimus thoracis* of DM than NM cattle although IGF-1 mRNA was similarly expressed in the normal and regenerating muscle of both cattle. In the differentiation medium cultures (DF cultures) but not the growth medium cultures (GR cultures), the mRNA expression of IGF-2 was significantly higher in DM than NM myoblasts. However, there were no changes of IGF-1 mRNA expression in the GR and DF cultures. In the both of NM and DM myoblast cultures, MSTN inhibited the fusion of myoblasts and the mRNA expression of MyoD and myogenin. Moreover, MSTN suppressed the mRNA expression of IGF-2 but not the mRNA expression of IGF-1 in DF cultures of NM and DM myoblasts. An inhibitor, SB431542, to activin receptor-like kinases (MSTN signaling molecules) abolished MSTN inhibitions on the fusion and MyoD mRNA expression of myoblasts. The mRNA expression of IGF-2 was augmented by an addition of SB431542 or both of MSTN and SB431542 in DF cultures. These results strongly indicate that IGF-2 expression is regulated by MSTN via activin receptor type IIB-Smad signaling pathway but IGF-1 expression is independent of MSTN during myogenesis of cattle.

Key Words: Myostatin, IGF-2, Bovine Myogenesis

434 Predicting lamb tenderness using proteomic analysis of 36 hour postmortem muscle. M. S. Updike*, A. Nichols, J. M. Reddish, H. Zerby, and M. Wick, *The Ohio State University*, *Columbus*.

Tenderness is one of three main components affecting palatability in lamb along with flavor and juiciness. Currently, carcasses are sorted into palatability classes using quality grade, a score based on physiological age and the amount of intramuscular adipose, which is only moderately correlated to tenderness. A method that would rapidly and accurately predict tenderness would be an advantage to the lamb industry. The long term goal of our laboratory is to create an immunochemical test strip which can accurately predict tenderness for consumers (7-14 d postmortem) at the time the carcasses move from the cooler for fabrication (24-48 h postmortem). Previous research from our lab used bovine myofibrils from 36 h to predict 7 d tenderness as proof of principle. To expand upon that research, 40 cross-bred lambs were harvested at The Ohio State University meat lab. Samples of Longissimus dorsi were taken at 36 h postmortem for proteomic analysis. Chops were assayed for tenderness using Warner Bratzler sheer (WBS) force at 7 d postmortem. Proteomic analysis samples were solublized in urea/thiourea buffer and run on SDS-PAGE using 5-20% gradient polyacrylamide gels. The gels were stained with Sypro Ruby® and the images were digitized. The resulting images were analyzed and the percent contribution of each band to the total was used in a reverse step wise regression on the WBS force value for that sample. Fourteen bands from the 36 h proteomic samples were identified that are associated with and predictive of 7 d tenderness ($r^2 = 0.88$, $p \leq 0.01$). These results suggest that an immunochemical test strip used at 36 h postmortem, based on these proteins, could accurately predict tenderness of lamb when it is consumed at 7 to 14 d postmortem.

Key Words: Lamb, Proteomics, Tenderness

435 Efficacy of the adsorbent AflaDetox in reducing the toxicity of dietary aflatoxin B1 in broilers. M. Denli*[1], J. C. Blandon[1], M. E. Guynot[2], S. Salado[2], and J. F. Perez[1], [1]*Animal Nutrition, Management and Welfare Research Group, Universitat Autònoma de Barcelona.*, *Barcelona, Spain*, [2]*Adiveter S.L. Agro-Reus*, *Tarragona, Spain*.

An experiment was conducted to evaluate the ability of AflaDetox as aflatoxin binding agent to reduce the deleterious effects of aflatoxin B1 (AFB1) in broiler diets. One hundred and twenty Ross 308 d-old male broiler chicks were individually weighed and assigned to eight treatments for 42 d. A 2 x 4 factorial arrangement of treatments was used. This involved the use of AFB1 at 0 or 1 mg /kg feed and AflaDetox at 0, 1, 2, and 5 g/kg feed. Animals were fed on the ground during the first 7 d, and in cages (3 chicks/cage; 5 cages/treatment) from 7 to 42 d. The BW, feed intake (FI), and feed conversion rate (FCR) were measured weekly. At the end of the experiment, blood samples were taken for serum analysis, the birds were sacrificed and the weights of liver and spleen were recorded. Dietary inclusion of AFB1 decreased ($P < 0.05$) BW (2,355 vs 2,049 g) and FCR (1.62 vs 1.78). It also resulted in a higher ($P < 0.05$) relative liver weight (2.09 vs 2.70%) and also higher ($P < 0.05$) serum activities of alkaline phosphatase (ALP; 2302 vs 3456 U/L) and aspartate aminotransferase (AST; 235.9 vs 314.5 U/L). A positive interaction ($P < 0.05$) was observed between AflaDetox and AFB1 contamination for most of the parameters studied. The addition of 1 g AflaDetox in the AFB1 contaminated diet increased ($P < 0.05$) BW and reduced ($P < 0.05$) the relative weight of liver (2.31%) and the serum activities of ALP (2103 U/L) and AST (257 U/L). Inclusion of AflaDetox at 2 or 5 g/kg feed in the AFB1-contaminated diets also improved ($P < 0.05$) FCR. The results indicated that inclusion of AflaDetox in contaminated diets may reduce the adverse effects of AFB1.

Key Words: Aflatoxin B1, Adsorbent, Poultry

436 Effect of OcraTox on the performance and egg quality of laying hens exposed to Ochratoxin A. M. Denli*[1], J. C. Blandon[1], M. E. Guynot[2], S. Salado[2], and J. F. Perez[1], [1]*Universitat Autonoma de Barcelona*, *Barcelona, Spain*, [2]*Adiveter, Agro-Reus, Tarragona*, *Spain*.

The efficacy of OcraTox (ADIVETER, S. L.) as an inhibitor of the deleterious effects of ochratoxin A (OTA) in laying hens was evaluated. A total of twenty-eight, 47-wk-old, Hisex-Brown laying hens, were divided into 4 groups (7 hens per group) with similar initial BW (1,793 ± 18 g) and egg production (99.8 ± 0.4%). Animals were distributed individually in cages and fed the following diets for 3 wk: 1) Control, 2) 5 g OcraTox/kg feed, 3) 2 mg OTA/kg feed and 4) 2 mg OTA/kg feed + 5 g OcraTox/kg feed. Daily feed consumption and egg weight were registered daily and feed efficiency was calculated as feed consumed per kg of egg. Percentage of egg production and egg mass (g/hen/d) were registered daily and calculated at the end of the study. Egg quality was studied by collecting the last 3 eggs produced by hen at the end of the trial. On day 21, blood samples were taken from all birds for analysis of serum biochemistry, the birds were sacrificed, and the weight of liver and spleen were recorded. Compared with the control, OTA decreased ($P<0.05$) feed consumption (127 vs 147 g/d), the egg mass (55.4 and 62.0 g) and albumen height (4.9 and 5.6 mm), yolk redness (18.8 and 20.1) and yellowness (44.4 and 46.3). Inclusion of OcraTox in the OTA diet increased ($P< 0.05$) feed consumption (136.7 g/d) and egg mass (59.4 g). It also alleviated ($P<0.05$) the negative effects of OTA on egg quality by improving albumen height (5.7 mm), yolk redness (20.7) and yellowness (46.0) to values no different ($P>0.05$) from control. Dietary inclusion of OTA decreased ($P<0.05$) serum concentrations of triglyceride, (785.2 and 1071.0 mg/dL), Ca (22.9 and 24.6 mg/dL), and P (4.1 and 5.7 mg/dL). It also increased ($P<0.05$)activity of alkaline phosphatase (1940.5 and 474.0 U/L). Inclusion of OcraTox in the diet ameliorated the negative effects of OTA on serum components that are usually altered by OTA. It is concluded that the use of OcraTox may diminish the deleterious effects promoted by OTA in laying hens.

Key Words: Ochratoxin A, Adsorbent, Laying Hens

437 Partitioning of external and internal bacteria carried by broiler chickens before processing. J. A. Cason*, A. Hinton, Jr., J. K. Northcutt, R. J. Buhr, K. D. Ingram, D. P. Smith, and N. A. Cox, *Russell Research Center*, *Athens, GA*.

Broiler chickens from the loading dock of a commercial processing plant were sampled to determine incidence and counts of index/indicator and pathogenic bacteria. Feathers were removed by hand from ten 6-wk-old chickens from each of seven different flocks and were rinsed in 400 mL of 0.1% peptone water. The heads and feet were removed and rinsed and the picked carcass was also rinsed (each in 200 mL of 0.1% peptone water). The ceca, colon, and crop were aseptically removed and stomached separately in 100 mL of peptone water. *Campylobacter* was present in six of the seven flocks. *Salmonella* was isolated from 50 of the 70 carcasses with at least two positive carcasses in each flock. More ($P < 0.05$) coliforms and *Escherichia coli* were found in the ceca than in the feather. Total external and internal counts were quite similar. Counts of *Campylobacter* were higher ($P < 0.05$) in the ceca and colon than in other samples. *Salmonella* was isolated in external samples from 46 of the 50 positive carcasses. *Salmonella* presence was approximately equivalent in all samples, indicating that contamination was distributed through all external and internal sampling sites. *Salmonella*-positive samples did not have higher counts of coliforms or *E. coli*. There were low correlations ($P < 0.05$) for counts of coliforms, *E. coli*, and *Campylobacter* in the ceca/feathers and ceca/colon comparisons, but not for *Salmonella*. The results emphasized that the pattern of bacterial contamination before processing is complex and highly variable.

Key Words: *Salmonella*, *Campylobacter*, Processing

438 *Campylobacter* colonization is reduced and gastrointestinal architecture is altered in turkey poults fed bacteriocins. I. Reyes-Herrera*[1], K. Cole[1], F. Solis de los Santos[1], A. M. Donoghue[2], N. J. Stern[3], E. A. Svetoch[4], B. N. Eruslanov[4], V. V. Perelygin[4], E. V. Mitsevich[4], I. P. Mitsevich[4], V. P. Levchuk[4], M. B. Farnell[2], P. J. Blore[1], and D. J. Donoghue[1], [1]*University of Arkansas*, *Fayetteville*, [2]*PPPSRU, ARS, USDA*, *Fayetteville, AR*, [3]*PMSRU, ARS, USDA, Russell Research Center*, *Athens, GA*, [4]*State Research Center for Applied Microbiology*, *Obolensk, Russian Federation*.

Campylobacter is a leading cause of foodborne illness in the U.S. Recent studies showed the reduction of *Campylobacter jejuni* in broiler chickens treated with bacteriocins produced by *Bacillus circulans* and *Paenibacillus polymyxa*. As *Campylobacter coli* is the most prevalent *Campylobacter* isolate recovered in turkeys, the objectives of this study were to evaluate the efficacy of these bacteriocins against *C. coli* colonization and the effect on the gastrointestinal architecture of young turkeys. In three separate trials, a total of 15-d-of hatch poults (n = 45/trial) were orally challenged on d 3 with approximately 10^6 cfu of a mixture of three *C. coli* isolates. Immediately before the bacteriocin treatment (d 10), cecal *Campylobacter* concentrations averaged 1.1 x 10^7 cfu/g of cecal contents (n = 15/trial). On d 10 to 12 posthatch, two treatment groups were given free access to feed supplemented with either one of two purified and microencapsulated bacteriocins, whereas the control group received untreated feed (n = 10/treatment group in each trial). After the 3-d dosing period, ceca and duodenal loops were collected. In each trial, we observed the elimination of detectable concentrations of cecal *Campylobacter* (detection limit, 1 x 10^2 cfu/g of cecal contents) vs the controls (1 x 10^6 cfu of *Campylobacter*/g of cecal contents). The evaluation of gastrointestinal samples showed a reduction ($P < 0.05$) in duodenal crypt depth and goblet cell numbers in the turkeys treated with either bacteriocin vs the controls. These modifications in gastrointestinal architecture may provide understanding of how bacteriocins inhibit *Campylobacter*.

Key Words: *Campylobacter*, Bacteriocin, Gastrointestinal Architecture

439 Litter treatment with aluminum sulfate produced a modest reduction in cecal *Campylobacter* colonization in chickens. M. L. Dirain, F. Solis de los Santos, I. Reyes-Herrera, P. J. Blore, and D. J. Donoghue*, *University of Arkansas*, *Fayetteville*.

Campylobacteriosis is a significant health problem worldwide and poultry products are a significant source of transmission. Treatment of poultry litter with aluminum sulfate (Alum) has been reported to reduce enteric *Campylobacter* concentrations in broilers. Little is known about how Alum reduces enteric *Campylobacter* concentrations. Therefore, this study was conducted to determine whether Alum reduces *Campylobacter* colonization in the ceca of broilers by reducing horizontal transmission between birds or by reducing *Campylobacter* concentrations in birds already colonized (therapeutic efficacy). Newly hatched broilers were reared in either no (controls), low (2.4 kg/3.0 m^2), or high (4.8 kg/3.0 m^2) levels of Alum (AlClear+). For the horizontal transmission group, *Campylobacter*-negative birds were reared with *Campylobacter*-positive ones that served as carriers. The carrier birds were fitted with leg bands to distinguish them from the rest of the birds in the pen. For the therapeutic efficacy group, all birds were inoculated with *Campylobacter* prior to placement in pens. During wk 1, 2, 4, and 6, cecal *Campylobacter* concentrations were determined in 10 birds from each treatment group. Furthermore, 20 g of litter were also collected once per week from each pen to monitor litter pH. For both the horizontal and vertical treatment groups, birds reared on high or low Alum also had lower ($P < 0.05$) cecal *Campylobacter* concentrations (approximately 2 logs) when compared with positive controls in pens not treated with Alum. The decline was similar for both groups. These changes were associated with a weekly reduction in litter pH in Alum treated pens when compared with the controls ($P \leq 0.05$). It is possible that the acidic environment of the litter reduces environmental *Campylobacter* levels and enteric recolonization via litter consumption (pecking). This may be the mechanism by which Alum reduces *Campylobacter* concentrations in poultry.

Key Words: *Campylobacter*, Colonization, Aluminum Sulfate

440 Effect of various concentrations of potassium hydroxide and lauric acid on native bacterial flora of broiler carcasses. A. Hinton Jr*, J. K. Northcutt, J. Cason, D. P. Smith, and K. D. Ingram, *Russell Research Center*, *Athens, GA*.

Experiments were conducted to determine the bactericidal effect of various concentrations of potassium hydroxide (KOH)-lauric acid (LA) solutions on native bacterial flora of broiler carcasses. A mixture of 1.0% KOH and 2.0% LA was prepared and filter sterilized. The 1.0% KOH-2.0% LA solution was diluted with sterile distilled water to prepare solutions of 0.25% KOH-0.5% LA and 0.5% KOH-1.0% LA. Eviscerated carcasses were washed twice in solutions of different concentrations of KOH-LA or in distilled water by shaking carcasses in 400 mL of the liquids for 1 min. Following each wash, a whole-carcass-rinse (WCR) was performed by using 400 mL phosphate buffer. Total plate count (TPC) of bacteria was performed. *Campylobacter* and *Escherichia coli* in the native bacterial flora were also enumerated by culturing the rinsates on plate count agar, *Campylobacter* agar, and 3M petrifilm *E. coli*/coliform count plates, respectively. Results indicated that fewer TPC bacteria were recovered from carcasses washed in either concentration of KOH-LA than from carcasses washed in distilled water. However, there was no difference ($P > 0.05$) in the number of bacteria recovered from carcasses washed in different concentrations of KOH-LA. While log 3.45 cfu/mL were recovered from carcasses washed in water, only log 1.43 cfu/mL were recovered from carcasses washed in 1.0% KOH-2.0 %. Additionally, there was no difference ($P > 0.05$) in the number of *Campylobacter* recovered from carcasses washed in water or in 0.25% KOH-0.50% LA. No *Campylobacter* were recovered from carcasses washed in 0.50% KOH-1.00% LA or 1.00% KOH-2.00% LA. There was no difference ($P > 0.05$) in the number of *E. coli* recovered from carcasses washed in water, 0.25% KOH-0.50% LA, or 0.50% KOH-1.00% LA. No *E. coli* were recovered from carcasses washed in 1.0% KOH-2.0 % LA. The results showed washing broiler carcasses in solutions of KOH-LA to have the potential to reduce bacterial contamination. The efficacy of these acids to induce a bactericidal effect, however, appears to depend on the concentration used.

Key Words: Poultry Processing, Lauric Acid, Potassium Hydroxide

441 Numbers of bacteria recovered from broiler carcasses and chiller water treated with hypochlorous and carbonic acids. J. K. Northcutt*[1], R. I. Huezo[2], K. D. Ingram[1], D. P. Smith[1], A. Hinton, Jr.[1], and J. A. Cason[1], [1]*USDA-Agriculture Research Service*, *Athens, GA*, [2]*The University of Georgia*, *Athens*.

A study was conducted to determine effects of treating poultry chiller water with a mixture of hypochlorous and carbonic acids. Broiler carcasses and chiller water were obtained from a commercial processing facility which had recently installed a TOMCO Pathogen Management System™ to recycle water in the middle compartment of a three-section chiller. Carcasses were sampled prechill and post-chill

during first and second shifts, while chiller water was sampled from the beginning and end of each of the three chiller compartments. Carcasses were subjected to a whole carcass rinse (WCR) in 0.1% peptone. Numbers of *Escherichia coli* (EC), coliforms (CF), and *Campylobacter* (CP) were determined from the WCR and chiller water samples. Prevalence of *Salmonella* (SAL) was also determined on the WCR and chiller water samples. Shift had no effect on numbers (EC, CF and CP) or prevalence (SAL) of bacteria recovered from carcasses or chiller water samples. On average, prechill levels of bacteria recovered from rinses were 2.6, 2.9 and 2.6 $\log_{10}$ cfu/mL for EC, CF and CP, respectively. Ten out of 40 (25%) prechill carcasses were positive for SAL. After chilling, numbers of EC, CF, and CP recovered from carcass rinses decreased by 1.5, 1.5, and 2.0 $\log_{10}$ cfu/mL, respectively. However, prevalence of SAL on post-chill carcasses (22% positive) was similar to prechill SAL prevalence. When chiller water samples were tested, EC, CF, and CP were recovered only in water collected from the first compartment of the chiller. Two out of four (50%) water samples collected from the entrance of the first compartment of the chiller tested positive for SAL. The results showed that a mixture of hypochlorous and carbonic acid can be used to recycle poultry chiller water and still achieve reductions in numbers of EC, CF, and CP and no increase in prevalence of SAL recovered from broiler carcasses.

Key Words: Poultry, Immersion Chilling, Carcass Bacteria

442 Effect of time and sand abrasion on recovery of aerobic bacteria, *Escherichia coli*, and coliforms from broiler carcasses. J. F. Hannah*[1], N. A. Cox[2], D. P. Smith[2], J. A. Cason[2], D. L. Fletcher[3], J. K. Northcutt[2], R. J. Buhr[2], and L. J. Richardson[2], [1]*University of Georgia*, *Athens*, [2]*USDA-ARS, Russell Research Center*, *Athens, GA*, [3]*University of Connecticut*, *Storrs*.

An experiment was conducted to determine effects of rinse time and sand abrasion on bacteria from whole broiler carcass rinses (WCR). Twelve eviscerated broiler carcasses were obtained from a commercial processing plant prior to chilling. Six carcasses were rinsed in 400 mL of 2.0% buffered peptone for 1 and 4 min in a mechanical shaker. The remaining carcasses were rinsed in the same manner, but with 100 g of sterile sand added to the rinse solution. Rinses were analyzed for aerobic bacteria (APC), *Escherichia coli*, and coliforms. For APC, *E. coli*, and coliforms, the levesl recovered from the sand rinses were higher ($P < 0.05$) than the levels recovered from the peptone rinses. The APC, *E. coli*, and coliforms collected from the peptone rinses were 4.0, 3.1, and 3.4 $\log_{10}$ cfu/mL of rinse, respectively. The APC, *E. coli*, and coliforms collected from the sand rinses were 4.6, 3.7, and 4.1 $\log_{10}$ cfu/mL of rinse, respectively. There were no differences ($P > 0.05$) in bacterial recovery between the two rinse times for either treatment. A secondary determination of treatment efficacy was conducted by swabbing a 25 cm^2 area of breast skin before and after rinsing. Using sand abrasion during WCR increased ($P < 0.05$) bacterial recovery and rinsing time was found to have no effect ($P > 0.05$)on such recovery. Additionally, WCR was a more sensitive method for recovery of bacteria than swabbing.

Key Words: Whole Carcass Rinse, Sand Abrasion, Bacteria

443 Bactericide and bacteriostatic activity of Chrysactinia Mexicana Gray in hens challenged with *E. coli* and *S. thypi*. J. C. Garcia-Lopez*, L. O. Hernandez-Artega, J. M. Pinos-Rodriguez, and B. I. Juárez-Flores, *Universidad Autónoma de San Luis Potosi*, *San Luis Potosi, S.L.P. México*.

Bactericide and bacteriostatic activity of Chrysactinia Mexicana Gray extract was evaluated in hens challenged with *S. thypi*, and *E. coli*. In the first part an in vitro trial five plant extracts were evaluated; aqueous, methylene chloride, ethanol and hexane. Zones of growth inhibition were measured for the bactericide trial and minimum inhibitory concentration (MIC) was determined. For the *in vivo* phase 30 Plymouth Rock Barred hens 21 weeks old (10 hens/treatment) were used with the following treatments: T1 control with no pathogen challenge and no plant extract; T2 pathogen challenged and ethanol extract of *C. mexicana* and; T3 pathogen challenged and bacitracin zinc. Colony-forming units (CFU) were counted in gizzard, crop, duodenum and cecum contents. There were differences ($P<0.05$) in the zones of growth inhibition of aqueous extract for *S. thypi* with the highest inhibition growth at a concentration of 20 mg/ml. In *E. coli* no differences were observed ($P>0.05$). For the chloride methylene extract, no differences ($P>0.05$) were found between the concentrations used in both pathogens. In the ethanolic extract there were differences ($P<0.05$) in the two bacteria with different concentrations being 20 mg/ml where the highest zones of growth inhibition hales were found. For the hexane extract there were differences ($P<0.05$) only for *S. thypi* with 20 mg/ml. The results for the minimum inhibitory concentration obtained for the ethanolic extract of *C. mexicana* showed a MIC for S. typhi of 0.025 mg/ml and *E. coli* 0.020 mg/ml. In the second phase the in vivo trial showed differences ($P<0.05$) for gizzard, crop and duodenum contents with a decreased number of CFU with the C. mexicana extract than those found with the use of bacitracin zinc. The number of CFU cecum content were similar ($P>0.05$) for the plant extract and the antibiotic. Results show that plant extract may be used to help to increase health status in hens in the backyard production systems in rural areas.

Key Words: Chrysactinia Mexicana, *E. coli*, Hens

444 Reduction of *Salmonella* in whole and ground turkey meat at refrigerated and elevated temperatures using lactic acid bacteria. J. Johnson*, C. Z. Alvarado, and M. M. Brashears, *Texas Tech University*, *Lubbock, TX*.

Lactic acid bacteria (LAB) are inhibitory against various pathogenic bacteria during growth and storage of ground meat. Thus, addition of LAB to turkey meat could provide an inhibitory effect on pathogens such as *Salmonella* due to production of inhibitory compounds. Three experiments were conducted with ground turkey (stored at 5°C) and portioned whole turkey meat (stored at either 5 or 37°C). Ground turkey was inoculated with 1 x 10^4 cfu/g of a 4-strain *Salmonella* cocktail. The two treatments included control (no LAB) and 1 x 10^6 cfu/g cocktail mixture of the 4 strains of LAB. The samples were stored in tray packs for 5 d at 5°C and were tested on d 0, 1, 2, and 3. Initial *Salmonella* counts on d 0 were similar but on d 3 the LAB-treated samples had a 2 log reduction in total *Salmonella*. In experiments 2 and 3, whole turkey breast lobes were inoculated with 1 x 10^4 cfu/g of the *Salmonella* cocktail. The two treatments included control (no LAB) and 1 x 10^6 cfu/g cocktail mixture of the 4 strains of LAB. The samples were stored in tray packs at either 5°C for 0, 1, 2, and 3 d or at 37°C for 0, 1, 2, and 4 h. In the 5°C study, there was a 2 log reduction by d 3 in the LAB-treated samples. In the elevated temperature study

(37°C), there were no differences in *Salmonella* at 0 or 1 h. However, by 2 h post-inoculation there was a 1.5 log decrease in the LAB-treated samples. By 4 h post-inoculation, there was a 2 log decrease in *Salmonella* recovery in the LAB-treated samples. Thus, our LAB cocktail appears to reduce growth of *Salmonella* in ground and whole turkey meat at refrigerated and elevated temperatures.

Key Words: *Salmonella*, Lactic Aid, Turkey Meat

445 Evaluation of serum as an indicator of antibiotic residues in edible poultry tissues. I. Reyes-Herrera*, V. Aguiar, M. L. Dirain, F. Solis de los Santos, J. H. Metcalf, P. J. Blore, and D. J. Donoghue, *University of Arkansas*, *Fayetteville*.

The FDA and USDA monitor food products, including poultry, to detect and prevent unsafe residues (e.g., drugs or pesticides) in the food supply. Monitoring procedures often require analysis of specific edible tissues (e.g., muscle). A potentially better option would be to evaluate blood samples collected directly from the processing line. Blood samples are usually easier to obtain and less expensive to analyze, do not require destruction of the carcass, and would represent any residue in the entire flock as opposed to an individual sample. However, it is unknown if residues in blood are correlated with residues in edible tissues. The objective of this study was to determine if antibiotic residue concentrations in blood are predictive of their concentrations in muscle tissues. The model antibiotic tested in this study was enrofloxacin. In this study, 5-wk-old broiler chickens (n = 156) were divided into two treatment groups and were dosed with either 25 ppm/3 d or 50 ppm/7 d of enrofloxacin (Baytril) in the drinking water. Blood and breast muscle samples were collected from six birds/group at 0, 1, 3, 6, 12, or 24 h during the first day of dosing and then every 48 h during the dosing period and every 12 h during the withdrawal period for up to 60 h post-withdrawal. Enrofloxacin was detectable within 1 h of dosing, reaching its plateau phase at 12 h (234 and 122 ppb for muscle and serum, respectively, for the 12-h sample from the 25 ppm/3 d dosing group), and was detectable for 36 h after drug withdrawal in both serum and muscle tissues. For all collection periods, enrofloxacin concentrations in blood (serum) were approximately half of those in muscle tissues. Because of this consistent relationship, monitoring blood samples may be an effective method to estimate antibiotic concentrations in edible tissues.

Key Words: Enrofloxacin, Edible Tissues, Poultry

446 Effects of blood in egg albumen on *Salmonella* survival and growth. D. P. Smith* and M. T. Musgrove, *USDA, Agricultural Research Service*, *Athens, GA*.

Two trials were conducted to determine effects of blood in table egg albumen on survival and growth of *Salmonella*. White-shell table eggs with blood spots were collected from a commercial egg processing plant after candling. In each trial eggs were broken out and approximately 4 mL of clear albumen (CLEAR) and 4 mL of bloody albumen (BLOOD) from each of 10 eggs were placed in sterile test tubes and inoculated with a nalidixic acid-resistant *Salmonella* Typhimurium. For inoculation, 0.1 mL of a *Salmonella* suspension (containing 2.9 log cfu/mL in Trial 1 and 7.1 log cfu/mL in Trial 2) was added to each tube. Tube contents were mixed and incubated at 22°C for 24 h. Immediately after inoculation and again after 24 h, 0.1 mL from each tube was plated onto brilliant green sulfa agar with nalidixic acid and incubated at 37°C for 24 h. Results were reported as log cfu/mL albumen. No differences ($P > 0.05$) in mean *Salmonella* counts were found for CLEAR or BLOOD samples in Trial 1 (averaging 1.6) or in Trial 2 (averaging 4.6) immediately after inoculation. In Trial 2, CLEAR samples had lower ($P < 0.05$) counts of *Salmonella* than BLOOD samples (4.8 vs 5.2) after 24 h. A vaild test was not appropriate for Trial 1 (24 h samples) because of reporting negative results due to the low inoculation level. Incidence of positive *Salmonella* samples in Trial 1 after 24 h was 3/10 for CLEAR samples and 8/10 for BLOOD samples. Results indicated that *Salmonella*, at the low inoculation level, appeared to survive somewhat better in bloody albumen than in clear albumen. At the high inoculation level, *Salmonella* numbers increased slightly in albumen without blood, but higher numbers were detected in bloody albumen. Thus, blood in the albumen of table eggs appears to support survival and growth of *Salmonella*.

Key Words: Table Eggs, Blood Spots, *Salmonella*

Forages and Pastures - Livestock and Poultry: Understanding Diet Selection in Temperate Biodiverse Pasture Systems

447 Dietary selection: The current state of knowledge. A. J. Rook*, *Private Consultant*, *Okehampton, UK*.

The current state of knowledge regarding dietary selection will be reviewed with particular emphasis on implications for temperate biodiverse pasture systems. It will be contended that dietary selection is not only key to optimising animal performance in these systems but also to minimising environmental impacts, whether through enhancing biodiversity and thus ecosystem functionality, minimising the impacts of animal excreta or reducing the carbon footprint of these production systems. Consideration will be given to progress made and key gaps in knowledge with respect to 5 questions. What do animals choose to eat? Where do they choose to eat? When do they choose eat? What mechanisms do they use to achieve these choices? Finally and most crucially, why do they make these choices? Methodological barriers to progress and the potential of new technologies to overcome them will be considered. Emphasis will be given to the importance of interdisciplinary collaboration and research at disciplinary interfaces. Key advances in recent years include the recognition of the importance of partial preferences, the complexity of spatial and temporal patterns in dietary choices, the role of social behaviour in modifying foraging decisions and the phenotypic plasticity in responses consequent upon learned behaviours from the dam or other conspecifics. However, most of this progress has been made using simple model and often artificial systems. In many cases we know the limits of the animals abilities in key traits but not how they interact in real world situations. Other key issues identified for further research include: 1) a better identification of the currencies that animals use to make their foraging decisions and the trade off between these currencies and with other behavioural needs; 2) a better understanding of the interplay between genetic,

ontological and environmental factors influencing foraging behaviour; 3) the need to better understand and integrate spatial and temporal variation into practical systems. A key component in delivery of this knowledge will be further improvement in our capacity to model these complex systems based on multi-species swards.

Key Words: Dietary Selection, Biodiversity, Pasture Systems

448 Genetic control of dietary choice in farm animals: A combination of nature and nurture. R. M. Lewis*[1] and G. C. Emmans[2], [1]*Virginia Polytechnic Institute and State University*, *Blacksburg*, [2]*Scottish Agricultural College*, *Edinburgh, Scotland, UK*.

Dietary choices reflect an animal's physiological state, such as its degree of maturity or pregnancy. As genotype affects growth and body composition it is expected to affect dietary intake and choice. Experience also affects dietary choice. Genetic variation in state variables such as growth rate and fatness of gain, which is substantial, conditions dietary choice. Evolutionary theory predicts that animals that forage more effectively will also survive and reproduce more effectively. Thus, natural selection will favor those adaptations, that may be morphological, physiological or behavioral, that enhance an animal's fitness within the constraints of its feeding environment. In wild animals in natural environments, body homeostasis appears to be genetically controlled, in part mediated through the animal's feed choice and intake. Obesity and anorexia, extremes on the continuum of body composition, seldom if ever occur because of reductions in fitness. Farm animals no longer subsist within the conditions in which they originally evolved. In controlled environments, feed energy may be in abundance and diet choice limited or non-existent. Artificial selection for increased growth rate and, more recently, against fatness, may interact with the rules that govern diet selection. Poultry provide a striking example. Selection for rapid growth over the past 50 years has increased food intake relative to body mass, with broilers growing four times more quickly and reaching market weight (2.2 kg) at about 6 weeks. In broiler breeders, feed intake is routinely controlled to avoid reproductive difficulties and to enhance livability. Lines selected for human purposes still appear to use the pre-existing rules controlling feed intake. The evidence on the selection of diet composition, either in controlled circumstances or in grazing mixed swards, is far less clear. In ruminants, there are no satisfactory models for predicting diet composition for existing genotypes. The effects, if any, of genetic selection is also unclear.

Key Words: Dietary Choice, Genetic Delection, Intake Models

449 Learning and dietary choice. J. J. Villalba*, *Utah State University*, *Logan*.

Early studies of foraging assumed diet selection was genetically programmed, and livestock production systems have traditionally viewed grazing animals as ″machines″ whose nutritional needs had to be provided in a prescribed manner. However, physiological needs and behavioral responses are not fixed. Rather, they have a significant learned component that enables animals to balance their diets when allowed to select among alternatives. Genes affect morphology and physiology, creating the bounds within which animals can use nutrients and cope with toxins, but genes do not operate in isolation. They are expressed, beginning at conception, through the interplay with the social and biophysical environments where an individual is reared. These interactions allow individuals to learn through trial and error (individual learning) and from the experience of others (social learning). Individual learning is illustrated by food preferences, which emerge from the animal′s experience with the interrelationship between a food′s flavor and its postingestive consequences. The senses of smell and taste enable animals to discriminate among foods. Postingestive feedback calibrates preference for food with its homeostatic utility. This mechanism allows animals to avoid poorly nutritious foods and foods high in toxins and to prefer nutritious foods, substances with health benefits, or arrays of foods that complement one another biochemically. Social learning is manifest through mother and peers. Lessons learned early in life from mother create a dichotomy between the familiar and the unfamiliar (novel), which is essential for survival. Animals prefer the familiar to the novel, and they regard anything novel with caution. Understanding how learning affects animal behavior and performance can facilitate the design of sustainable grazing systems to improve the quality of land as well as the nutrition, health and welfare of animals. Incorporation of learning into grazing systems involves offering livestock diverse and biochemically complementary plant species, such that through individual and social experiences animals balance their consumption of nutritional and medicinal compounds.

Key Words: Diet Selection, Learning, Experience

450 Forage factors and dietary choice. D. F. Chapman*[1], A. J. Parsons[2], J. Hill[1], and K. Venning[1], [1]*University of Melbourne*, *Melbourne, Victoria, Australia*, [2]*AgResearch*, *Palmerston North, New Zealand*.

When offered a free choice between different forage species presented in a pasture association, ruminants will choose a mixed diet, even when one dietary component could meet all of their nutritional needs. Thus, preference and selection cannot be explained simply by the common measures of species nutritive or feeding value. The question then arises, what is the nutritional basis of the dietary choices that animals make? This review focuses on the forage composition factors that might be implicated in dietary choices made by grazing ruminants. The satiety theory is used to develop propositions about the physico-chemical attributes of forages that influence grazing behaviour. We present evidence that animals eating only clover (with relatively high rumen degradable protein content) take shorter meals than animals eating only grass (with relatively low rumen degradable protein content), or a mixture of grass and clover. Thus, total daily intake is reached by different combinations of meal length, meal number and intake rate on pure clover, pure grass, and mixed diets. We extend these observations by proposing that satiety in the case of the clover-only diet is related to the rate of release of ammonia from the soluble protein fraction of the forage, and subsequent uptake in the blood to levels that can approach toxicity if the ammonia is not removed by excretion as urea. Mixing grass with the clover allows animals to eat longer meals, perhaps because the better dietary balance of energy to soluble protein helps control ammonia accumulation rates. Rumen ammonia and gas profiles from in vitro studies suggest that digestive efficiency is optimal at a dietary clover: grass ratio of approximately 0.7:0.3, which corresponds closely to the partial preferences observed in free choice field experiments. Direct, real-time information on the relationships

between forage physico-chemical factors and meal initiation, cessation, and dietary switching is needed to further develop propositions about the control of dietary choices.

Key Words: Grazing, Intake, Dietary Choice

451 New approaches to grazing effects on pasture composition and productivity. E. A. Laca*, *Plant Sciences, University of California*, *Davis*.

Herbivory can have dramatic impacts on productivity, composition and functioning of grassland and pasture ecosystems. Yet, our ability to manage these effects has been limited, both by the traditional paradigms and by factors selected to manage grazing systems. These paradigms assume that grazing, plant growth, and ecological interactions are uniform and vary continuously over space and time. Management factors considered are total and seasonal forage demand, animal density, and duration of grazing. A typical analysis of grazing systems under this paradigm is a plot of herbage mass vs. time with various levels of stocking rate. Diet selection is represented as the proportion of each species grazed, which potentially affects the competitive interactions among pasture species across the pasture. These interactions are assumed to be constant over space and time. Further progress in grazing science and management requires implementation of a new and more complex paradigm that incorporates spatially and temporally distributed ecological interactions such as herbivory, growth, competition, and abiotic conditions. Although it is well established that grazing impact on a plant depends on its individual state, this has rarely been fully incorporated in the study and planning of grazing. The temporal and spatial dynamics of productivity and composition of pastures is sensitive to the initial state of the sward and to the spatiotemporal distribution of defoliation at scales much smaller than the typical paddock. Competitive dominance among plant species varies with ecological conditions. Thus, impact of defoliation on competition varies over space and time. I outline a model that shows the convergence of new ecological understanding of herbivory and pasture dynamics towards a new paradigm for researching grazing management tools. Technologies to monitor and control animal distribution are evolving rapidly and create management and research opportunities to experimentally address a new paradigm where there is a tighter link between manipulation of grazing and practical results.

Key Words: Grazing Systems, Plant-Animal Interactions, Spatial Ecology

Goat Species: Nutrient Requirements of Goats

452 Goat species: Nutrient requirements of goats - Introduction. J. E. Huston*, *Texas A&M University*, *San Angelo*.

The National Research Council recently released the first issue of *Nutrient Requirements of Small Ruminants* addressing the nutrient requirements for goats along with those for sheep and various cervid and camelid species. Specialists from various regions within the U.S., Australia, and Mexico were appointed in April 2004, and charged with gathering existing information and writing the report. The report was prepared to accommodate a broad readership that varied in both informational interest (species, physiological bases for nutrient requirements, tabular data, practical application, etc) and depth of training. Fourteen chapters summarize published information on comparative anatomy and gastrointestinal function, functions and requirements of nutrients, nutrient sources and intake, common deficiencies and deficiency symptoms, and other considerations as they pertain to the species considered. Usually, general discussion of the chapter topic is followed by discussions targeting the individual species. An extensive list of references is provided at the conclusion of each chapter. Individual tables list the nutrient requirements for the different species, and feed composition tables describe common feedstuffs, novel feedstuffs, and mineral supplements. The tables listing the nutrient requirements of goats provide separate entries for dairy, meat, and Angora goats as influenced by age, sex, body size, physiological stage (e.g., maintenance, growth, breeding, gestation, and lactation), and level of production (e.g., growth rates, litter sizes, and levels of milk production). Tables listing contents of common feedstuffs and mineral supplements are extensive and similar to those contained in other National Research Council reports. The table describing novel feedstuffs is unique to this publication and compiles information on feeds particularly important to small ruminants in their natural settings and managed by individuals of diverse cultures. The authors of this report are excited about its use in providing information to its readership and its role in stimulating discovery of new research information for subsequent improved issues.

Key Words: Nutrient Requirements, Small Ruminants, Goats

453 Energy and protein requirements of goats. M. Huerta Bravo*, *Universidad Autónoma Chapingo*, *Chapingo, México*.

The objective is to disseminate the new NRC recommendations about energy and protein for goats. Previous energy maintenance requirements were estimated as metabolizable energy (MEm) with a single equation for all goat types and conditions, with an adjustment for activity. Now, maintenance requirements (ME_m) are given for suckling or preweaning, growing, and mature goats. Also, goat breeds are grouped as meat, dairy, indigenous, and Angora. A 15 percent difference in ME_m among intact males vs females and wethers is assumed. An adjustment factor for body condition score and weeks after low nutritional plane stops and adequate nutritional plane starts may be included to estimate ME_m. Grazing activity considers grazing plus walking time, organic matter digestibility, and terrain score to calculate an adjustment for ME_m. Additionally, ME_m may be adjusted by environmental temperature. Metabolizable energy for gain considers suckling or preweaning, growing, and mature goats. For angora goats, requirements for gain are separated for nonfiber tissue gain (ME_{tg}) and clean mohair fiber gain (ME_f). Metabolizable energy requirements for

lactation (ME_l) are estimated as 1.25 Mcal for I kg of 4 percent fat corrected milk, and a value was given for mobilized tissue. Pregnancy requirements consider average birth weight per kid, day of gestation, and litter size. Previous protein requirements were given as crude (CP) or digestible crude protein. The new recommendation considers metabolizable protein (MP) for all functions. A conversion of MP to CP is given to facilitate its use. An estimate of rumen degraded intake protein is also given as a general guideline.

Key Words: Energy, Protein, Goats

454 Vitamin requirements of goats. B. W. Hess*, *University of Wyoming*, *Laramie*.

Vitamins are a group of complex organic nutrients that are essential for multiple metabolic processes but, unlike other organic nutrients, vitamins are required in minute amounts (µg to mg/d). Because estimates of endogenous vitamin losses are non-existent, vitamin requirements are based on animal responses during feeding trials. Recommendations for vitamin requirements are complicated by selection of the criteria by which the vitamins are judged adequate or inadequate. As in past NRC publications, vitamin requirements of goats are often derived from values for sheep. Unlike previous requirements for vitamin A, newly established requirements are based on the animal′s ability to maintain 20 µg of retinol/g of liver and are expressed as retinol equivalents (RE). Daily intake of 31.4 RE/kg of live BW is deemed necessary for animals at maintenance. Vitamin A requirements increase to 45.5 RE/kg of live BW for nannies during late gestation, 53.5 RE/kg of live BW for lactating nannies, and 100 RE/kg of live BW for growing kids. Due to insufficient data published to the contrary, the vitamin D requirements for all classifications of goats are comparable to previous recommendations. Daily vitamin E intake of 5.3 IU/kg of live BW is required to maintain blood α–tocopherol concentrations ≥ 2 µg/mL. Provision of 5.6 IU/kg of live BW during late gestation is recommended to increase serum α–tocopherol concentrations of the neonate. Vitamin E requirements increase to 10 IU of vitamin E/kg of live BW when the goal is to enhance immune response or extend the storage case life of meat. In general, vitamin K and water–soluble vitamin requirements of goats can be met by escape of dietary sources from ruminal metabolism and through endogenous synthesis (microbial or bodily). Although several studies have demonstrated production or health benefits when diets have been supplemented with water–soluble vitamins, the amounts of vitamins given to induce such responses are usually for specialized situations and may not necessarily reflect requirements for various production functions. Additional research is needed to establish recommendations for requirements of water-soluble vitamins for goats.

Key Words: Goats, Vitamins, Requirements

455 Revised guidelines for mineral requirements of goats. S. G. Solaiman*, *Tuskegee University*, *Tuskegee, AL*.

Mineral requirements of an animal largely reflect the nutritional demands during different physiological phases. Minerals are required for maintenance, growth, conceptus product formation, and milk production. Borderline mineral intake may compromise animal performance and longevity. Specific mineral deficiencies vary and animal may deplete the pool of tissue minerals before deficiency symptoms are exhibited. Inadequate mineral supplies may reduce production, prolong the duration of parturition, increase the number of stillbirths and result in a higher occurrence of skeletal problems. Many advances in mineral nutrition and metabolism have resulted in establishing guidelines for requirements of different species. However, there are relatively few original scientific research reported on mineral nutrition and metabolism of goats that can be used in establishing the guidelines for this species. Also most of the reported literature is largely speculation based on analogy with cattle and sheep, thus, made our task more challenging. However, few advances in recent years have allowed more specific recommendations for some macro and trace minerals based on goat data. The present report is an assessment of original research conducted on goats and where possible, mineral requirements are calculated by factorial methods using goats, cattle and sheep data. Therefore, the proposed requirements are generalizations and their application to specific breeds and conditions may vary.

Key Words: Goat, Minerals, Requirements

Growth and Development - Livestock and Poultry I

456 Specie and age effects on IGF mRNA expression in the amniotic and allantoic membranes and jejunum of developing avian species. D. M. Karcher* and T. J. Applegate, *Purdue University*, *West Lafayette, IN*.

Insulin-like growth factor (IGF) concentrations change in amniotic and allantoic fluids during development in the chicken, duck, and turkey. However, IGF contribution by the embryo has not been evaluated. This study investigated mRNA transcript abundance in the amniotic and allantoic membranes and jejunum throughout development and among three avian species. Eggs were set (540/specie) and 5 embryos were sampled every other day during incubation through 7 days post-hatch. RNA was extracted and mRNA transcripts for IGF-I, IGF-II, and IGF-R were evaluated by quantitative PCR at d -7, -4, 0 (hatch), 1, 3. Statistical differences were detected using proc mixed in SAS. The starting abundance of chicken IGF-I mRNA in the allantois increased 25-fold from d -7 of incubation to d -4. Within d -4, chicken IGF-I transcript abundance was 8.6 times greater than turkey ($P<0.05$) in the allantoic membrane. However, no differences were detected in membranes for IGF-II or IGF-R among species. The jejunum was evaluated prior to hatch and both jejunum and jejunum mucosa post-hatch. IGF-I transcript abundance was 3.4 fold higher ($P<0.05$) in the chicken compared to turkey at d -7. Turkey and duck were significantly lower ($P<0.05$) than chicken at d -4 in the jejunum. The chicken jejunum IGF-I transcript peaked at 1 d post-hatch versus ($P<0.05$) hatch and 3 d post-hatch. Chicken IGF-I mRNA in the jejunum was significantly higher ($P<0.05$) than both duck and turkey at 1 d post-hatch. The IGF-I mRNA in the duck's jejunal mucosa peaked at 3 d post-hatch and was significantly greater ($P<0.05$) than turkey and chicken at 3 d post-hatch. Chicken jejunum contained significantly ($P<0.05$) more IGF-I transcript when compared to the jejunum mucosa at 1 d post-hatch, while duck jejunum mucosa was statistically ($P<0.05$)

greater than the jejunum at 3 d post-hatch. Greater transcript abundance in the mucosa at 3 d post-hatch may lead to higher IGF-I protein expression enhancing IGF-I effects on jejunum mucosa. No differences were observed in jejunum or jejunum mucosa for IGF-II or IGF-R during the incubation or post-hatch periods for all three species suggesting the majority of transcript is produced within the mucosa.

Key Words: IGF, Amnion, Small Intestine

457 The role of glypican-1 glycosaminoglycan chains in myogenic satellite cell proliferation, differentiation, and fibroblast growth factor 2 responsiveness. X. Zhang*[1], C. Liu[1], K. E. Nestor[1], D. C. McFarland[2], and S. G. Velleman[1], [1]*Ohio Agricultural Research and Development Center, The Ohio State University*, *Wooster*, [2]*South Dakota State University*, *Brookings*.

The glypicans are a family of cell-surface heparan sulfate proteoglycans consisting of a core protein covalently attached with glycosaminoglycans (GAG). Only glypican-1 is expressed in skeletal muscle and increases in expression during myoblast differentiation. Previous studies have suggested that glypican-1 influences fibroblast growth factor 2 (FGF2) signaling pathway by its heparan sulfate chains. A turkey glypican-1 full length cDNA (1,650 bp, GenBank acc. no. AY551002) with three potential GAG attachment sites at Ser483, Ser485, and Ser487 was cloned into the pCMS-EGFP vector. To investigate the functional contribution of each GAG chain, the wild type glypican-1, one-chain and no-chain mutants, and the pCMS-EGFP vector without an insert were transfected into turkey myogenic satellite cells. The transfected cell cultures were assayed for cell proliferation, differentiation, and FGF2 responsiveness. All the data were summarized as mean ± SEM analyzing by an ANOVA and two-sided P values of $P < 0.05$ were considered statistically significant. The overexpression of wild type glypican-1 increased FGF2 responsiveness during proliferation and increased the process of differentiation but did not affect proliferation when compared to the one-chain, no-chain mutants, and the pCMS-EGFP vector without an insert. To support the overexpression data, glypican-1 expression was reduced using a small interfering RNA against turkey glypican-1. Inhibition of glypican-1 expression decreased myogenic satellite cell proliferation, differentiation and FGF2 responsiveness during proliferation. We conclude that glypican-1 function requires all the GAG chains for myogenic satellite cells to increase FGF2 responsiveness during proliferation and to affect the process of differentiation.

Key Words: Glypican, Muscle, Turkey

458 Reduction in cell responsiveness to transforming growth factor-beta by decorin overexpression increases satellite cell proliferation and differentiation. X. Li*[1], D. C. McFarland[2], and S. G. Velleman[1], [1]*Ohio Agricultural Research and Development Center, The Ohio State University*, *Wooster*, [2]*South Dakota State University*, *Brookings*.

Muscle development is a highly organized process regulated by interactions between muscle cells and their extracellular matrix (ECM) environment. The ECM, through its regulation of growth factors, plays a pivotal role in muscle growth and repair. Transforming growth factor-beta (TGF-β) is a potent inhibitor of muscle cell proliferation and differentiation. Decorin, a small ECM proteoglycan, binds to TGF-β and modulates TGF-β activity during muscle cell growth and development. However, its interaction with TGF-β is not well characterized. The objective of this study was to examine the interaction of TGF-β and decorin during myogenesis. Chicken myogenic satellite cells isolated from the pectoralis major muscle were used to investigate the biological functions of TGF-β and decorin during myogenesis. Satellite cells are considered to be myogenic precursors for muscle growth and repair. In the present study, the satellite cells were transfected in vitro with a full-length chicken decorin cDNA. The effect of decorin on cell proliferation was monitored by measuring the DNA content of sample wells. The effect of decorin on cell differentiation was assessed by measuring changes in muscle-specific creatine kinase levels. Decorin overexpression increased both satellite cell proliferation and differentiation rates compared to the control cells. Furthermore, decorin overexpressing satellite cells were less sensitive to TGF-β during both proliferation and differentation. These results suggest that decorin reduces satellite cell responsiveness to TGF-β signaling, leading to an increase in satellite cell proliferation and differentiation.

Key Words: Decorin, Transforming Growth Factor-Beta, Satellite Cell

459 Bone mineralization in four Cobb pedigree lines of meat-type chickens. P. Talaty*[1], M. N. Katanbaf[2], and P. Y. Hester[1], [1]*Purdue University*, *West Lafayette, IN*, [2]*Cobb-Vantress, Inc.*, *Monticello, KY*.

Previous work in our laboratory showed that 4 strains of commercial broilers (Cobb 500, Cobb 500T, Ross 308, and Cobb 700) did not differ in bone mineralization (Talaty et al., 2006, Poultry Sci. 85: (suppl. 1): 16). The purpose of the current study was to determine the variability of bone mineral density (BMD) and bone mineral content (BMC) of the tibia and humerus of four pedigree lines of Cobb breeders from 6 to 24 wk of age. Four purebred lines (A, B,C, and D) of male and female Cobb breeders were each placed in littered floor pens of 3 replicates each from hatch to 24 wk of age at stocking densities similar to industry standards. Feed restriction was initiated at 6 wk of age. Healthy birds without lameness and broken bones were selected for scans at 6, 15, and 24 wk of age. Different birds were scanned at each age. Bone mineralization of 9 birds/line/sex/age was determined using dual energy X-ray absorptiometry (DEXA).Using the mixed model procedure of SAS, mineralization data were analyzed using an analysis of covariance with BW as a covariant. Results indicated that the CV for BMD and BMC ranged from 11 to 19%. The BMD was similar among pedigree lines. An age related increase ($P < 0.001$) in BMD occurred between 6 wk (mean = 0.224^{b} g/ sq cm, CV = 14%) and 15 wk (mean = 0.244^{a} g/sq cm, CV = 13%) with no further increase noted at 24 wk of age (mean = 0.244^{a} g/sq cm, CV = 17%). The BMC was similar among pure-bred lines of Cobb chickens at 6 and 15 wk of age; however, at 24 wk of age, Line C had higher BMC than Lines A and D, but did not differ from Line B resulting in a line × age interaction ($P < 0.01$).The higher BMC of Line C was mainly due to increase bone length and bone area. Since differences in BMC among lines did not occur until 24 wk of age and there were little to no differences in BMD among pedigree lines of chickens suggest that 6 to 8 wk old progeny derived from these lines may not differ in bone mineralization.

Key Words: Bone Mineralization, Bone Mineral Density, Pedigree Chickens

460 Identification of two novel chicken growth hormone-releasing hormone receptor (GHRHR) splice variants: Implications for the role of Asparagine residue (Asp^{56}) in receptor activation and direct ligand-receptor interaction. C. Y. Wang*, Y. Wang, A. H. Y. Kwok, and F. C. Leung, *The University of Hong Kong*, *Hong Kong, HK-SAR, China*.

In this study, two novel Growth Hormone-releasing Hormone Receptor (GHRHR) splice variants, named cGHRHR-v1 and cGHRHR-v2 respectively, were identified from chicken pituitary using RT-PCR assay. cGHRHR-v1 is a variant of 383 amino acids and characterized by an N-terminal deletion of 36 amino acid residues (encoded by exon 3) including an asparagine at position 56 (Asp^{56}) conserved in all members of subfamily B-III G protein-coupled receptor. cGHRHR-v2 is a C-terminally truncated receptor variant of 284 amino acids with 4 putative transmembrane domains, which arises from alternative usage of a splicing acceptor site located at the 3′ end of intron 8. Using pGL3-CRE-luciferase reporter system, the functionalities of the two variants were examined in CHO cells. cGHRHR-v2 could not transmit signal after agonist treatment. In contrast, cGHRHR-v1 is still likely a functional receptor. Both GHRH and pituitary adenylate cyclase-activating polypeptide (PACAP) could activate cGHRHR-v1 at high dosages (GHRH $\geq 10^{-8}$M; PACAP, $\geq 10^{-6}$M) and GHRH appeared to be much more potent than PACAP, suggesting that cGHRHR-v1 is a membrane-spanning receptor with an impairment in high affinity ligand binding, rather than in receptor activation or ligand-binding specificity. Meanwhile, this finding points out the possibility that Asp^{56} is not critical for receptor activation and direct ligand-receptor interaction. To substantiate this hypothesis, using site-directed mutagenesis, two receptor mutants with replacement of Asp^{56} by Ala or Gly were generated. Expectedly, GHRH and PACAP could activate both receptor mutants with slightly, but significant, reduced potencies. Taken together, our findings not only suggest that cGHRHR variants may play a role in controlling normal pituitary functions, but also support the notion that Asp^{56} is nonessential for receptor activation and direct ligand-receptor interaction.

Key Words: GHRH, GHRHR, Pituitary

461 Feed restriction alters the temporal expression of skeletal fast myosin isoforms in the breast muscle of diverse lines of turkeys. K. M. Huffman*, J. M. Reddish, M. S. Lilburn, and M. Wick, *The Ohio State University*, *Columbus*.

Significant increases for body weight and breast muscle proportion in commercial broiler and turkey strains have been made by genetic selection; however, the mechanisms of breast muscle growth and effects of such selection have not been fully explained. Our hypothesis is that feed restriction alters the temporal expression pattern of neonatal fast skeletal and adult fast skeletal myosin isoforms in the Pectoralis major (PM) of developing poults. We evaluated this hypothesis with a poultry growth model consisting of a random bred control line (RBC2) and a line selected for body weight at 16 weeks of age (F-line). The F-line has significantly heavier breast muscle weight than the RBC2 but the RBC2 breast muscle in proportion to body weight is similar to the F-line. Physiological differences between the lines have been normalized in previous research by restricted intake. We duplicated this approach to compare the temporal expression of neonatal and adult myosin isoforms in both restrict fed and ad libitum fed F and RBC2 poults. Our objective, using a quantitative indirect enzyme linked immunosorbent assay (ELISA) with fast skeletal myosin isoform specific monoclonal antibodies, was to investigate the affect of feed restriction on the temporal expression of neonatal and adult myosin isoforms in developing poults. Conclusions were made by comparing the ratios of the neonatal and adult myosin isoforms in the PM from the control line of poults (RBC2) and the F-line poults under ad libitum and restrict fed nutritional environments. Our results demonstrate that adult myosin isoform expression is delayed in both the F- and RBC2-lines undergoing feed restriction ($p<0.05$). Similarly, feed restriction resulted in a delay in the down-regulation of the neonatal myosin isoform at 14 and 21 d of age in both lines ($p<0.05$). These results confirm our hypothesis, that feed restriction alters the age related expression pattern of both the neonatal and adult myosin isoforms in the pectoralis major of both turkey lines.

Key Words: Muscle, Turkey, Myosin

462 Expression of the carbohydrate response element binding protein gene and related genes involved in hepatic lipogenesis during post-hatch development of broiler chickens. M. Proszkowiec-Weglarz*[1], B. D. Humphrey[2], M. P. Richards[1], R. W. Rosebrough[1], J. P. McMurtry[1], and R. Angel[3], [1]*USDA-ARS*, *Beltsville, MD*, [2]*California Polytechnic State University*, *San Luis Obispo*, [3]*University of Maryland*, *College Park*.

Carbohydrate response element binding protein (ChREBP) and sterol regulatory element binding protein-1c (SREBP-1c) are key regulators of glucose metabolism and lipid synthesis in mammals. In response to glucose (ChREBP) and insulin (SREBP-1c), these two transcription factors regulate expression of lipogenic genes such as acetyl-CoA carboxylase (ACC), fatty acid synthase (FAS), stearoyl-CoA desaturase 1 (SCD1), ATP citrate lyase (ACL), and malic enzyme (ME). ChREBP dimerizes with Max-like protein X (Mlx) and binds to carbohydrate response element sites in target gene promoter regions. Expression of ChREBP and SREBP-1c is regulated, in part, by the nuclear liver × receptor (LXR). Since the ChREBP gene has not been identified in birds, the aim of this work was to clone and determine the expression of ChREBP and related genes in broilers during post-hatch (PH) development. To determine mRNA expression by RT-PCR and capillary electrophoresis, total RNA was isolated from 10 different tissues from 3-wk-old birds and from the livers of birds at 0, 1, 2, 3, 4, 6, and 8 d PH that were fed or fasted for 48 h PH. ChREBP, SREBP-1c, Mlx, and LXR gene homologues were expressed in all tissues examined at 3 wk. ChREBP demonstrated significant tissue-specific expression with the highest mRNA levels in liver and duodenum. Fasting for 48h PH did not change the level of ChREBP or Mlx mRNAs in liver, whereas SREBP-1c mRNA was lower at 2 d in fasted compared to fed chicks. Hepatic ACC, FAS, SCD1, and ME mRNAs increased in response to feeding. Fasting for 48 h PH delayed the rise in lipogenic gene mRNAs but had no effect on plasma insulin or glucagon. We conclude that ChREBP and Mlx genes are expressed in chickens. However, the role of these transcription factors in the glucose-dependent regulation of lipogenesis remains to be shown in birds.

Key Words: ChREBP, Lipogenesis, Chicken

463 The activation of insulin and nutrient signaling components leading to translation initiation in skeletal muscle of neonatal pigs is developmentally regulated. A. Suryawan*, R. A. Orellana, A. S. Jeyapalan, H. V. Nguyen, J. R. Fleming, and T. A. Davis, *USDA/ARS Children's Nutr. Res. Ctr., Department Pediatrics, Baylor Coll. of Med.*, *Houston, TX*.

Insulin (INS) and amino acids (AA) act independently to stimulate protein synthesis in skeletal muscle of neonatal pigs and the responses decrease with development. The purpose of this study was to compare the effect of INS and AA on the activation of signaling components leading to translation initiation and how these responses change with development. To examine the independent role of INS, hyperinsulinemic-euglycemic-euaminoacidemic clamps were performed in fasted 6-d-old (n=4) and 26-d-old (n=6) pigs to raise plasma insulin from 5 (fasting level) to 30 (fed level) μU/ml while AA and glucose were maintained at fasting levels. To elucidate the independent role of AA, a balanced AA mixture was infused into fasted 6-d-old (n=4) and 26-d-old (n=6) pigs to raise branched-chain amino acids from 500 (fasting level) to 1000 μmol/L (fed level) while INS and glucose were maintained at fasting levels. INS, but not AA, increased the phosphorylation of protein kinase B. Both INS and AA increased the phosphorylation of mammalian target of rapamycin (mTOR), ribosomal protein S6 kinase-1, and eukaryotic initiation factor (eIF) 4E-binding protein 1 (4E-BP1) and these responses were higher in 6-d-old compared to 26-d-old pigs ($P<0.05$). In 6-d-old pigs, both INS and AA reduced the binding of raptor to mTOR ($P<0.05$). Both INS and AA decreased the binding of 4E-BP1 to eIF4E ($P<0.05$) and increased eIF4E binding to eIF4G ($P<0.05$); these effects were greater in 6-d-old than in 26-d-old pigs ($P < 0.05$). Furthermore, neither INS, AA, nor age had any effect on the phosphorylation of eukaryotic elongation factor 2. Our results suggest that the activation of many of the insulin and nutrient signaling components leading to translation initiation is developmentally regulated and parallels the developmental decline in protein synthesis in skeletal muscle of neonatal pigs.

(NIH AR44474, USDA 58-6250-6-001)

Key Words: Protein Synthesis, Skeletal Muscle, Pig

Immunology - Livestock and Poultry II

464 Effects of maternal nutrition and selenium supplementation on absorption of IgG and survival of lambs. C. J. Hammer*[1], K. A. Vonnahme[1], J. B. Taylor[2], D. A. Redmer[1], J. S. Luther[1], T. L. Neville[1], J. J. Reed[1], J. S. Caton[1], and L. P. Reynolds[1], [1]*North Dakota State University*, *Fargo*, [2]*USDA-ARS, U.S. Sheep Experiement Station*, *Dubois, ID*.

To examine the effects of maternal nutrition with or without additional selenium (Se) on absorption of IgG and survival of lambs, 82 Rambouillet ewe lambs were allotted randomly to one of six treatments in a 3 x 2 factorial design. Groups included dietary levels of Se [Adequate Se (ASe, 7.4 μg/kg BW) vs. High Se (HSe, 85 μg/kg BW)], and plane of nutrition [60% (RES), 100% (CON), and 140% (HIGH) of NRC requirements for gestating lambs]. Basal diets were fed once daily in a complete pelleted form and HSe ewes received a Se pellet to meet the required Se level. Upon parturition, lambs were immediately separated from their dams, weighed, and serum samples obtained. Lambs were fed artificial colostrum for the first 20 h after which lambs were fed milk replacer. The artificial colostrum contained 64.3 g IgG/L and lambs received 10.6 g IgG/kg BW divided into seven feedings. At 24 h post-parturition serum samples were obtained to assess IgG status. Lambs were reared similarly in a temperature controlled (12°C), and ventilated facility for the duration of the study. Signs of illness prompted treatment following protocol. Morbidity was assessed as number of days treated for respiratory or gastrointestinal symptoms. Mortality was calculated as days in flock. Plane of maternal nutrition affected ($P < 0.05$) ability of lambs to absorb IgG after birth, with 24 h IgG concentrations of 2276, 1586, and 1214 mg/dl for lambs from RES, CON, and HIGH respectively. Selenium supplementation of ewes decreased ($P < 0.01$) 24 h IgG concentrations in lambs from 1912 mg/dl for ASe to 1472 mg/dl for HSe. Morbidity was not different for lambs from ewes in any of the treatment groups. Mortality was greater ($P < 0.01$) for offspring of ewes in the HIGH group; this group also had the lowest 24 h IgG concentration. Lambs born from ewes on a high or low plane of nutrition or with high dietary Se appear to have an altered ability to absorb IgG after birth. Further research is needed to determine the mechanisms by which this occurs.

Key Words: IgG, Mortality, Lamb

465 Effect of supplementation with a *Bacillus*-based direct-fed microbial on immune development of dairy calves. K. Novak*[1], E. Davis[1], C. Wehnes[1], T. Rehberger[1], D. Shields[2], and J. Coalson[2], [1]*Agtech Products, Inc.*, *Waukesha, WI*, [2]*Merrick's, Inc.*, *Union Center, WI*.

Immune development was evaluated in 65 Holstein bull calves in response to the addition of a *Bacillus*-based direct-fed microbial (DFM) to electrolyte scour treatment. Calves were assigned to three treatments based on the presence of scours: non-scouring, electrolyte, and electrolyte+DFM. Scouring calves received electrolyte for a mandatory two days. Blood was sampled from eight calves from each treatment on d 3, 7, 14, 21, 28, and 42 post-placement for an analysis of leukocyte populations by flow cytometry. Immune cell populations were determined using a panel of monoclonal antibodies specific for various cell surface markers, including, CD4 (T helper cells), CD8 (cytotoxic T and natural killer cells), CD25 (IL-2 receptor), CD62L (L-selectin), TCR1 (γδ T cell receptor), AM-2 (activated γδ T cells), CD45RO (memory T cells), CD172a (monocytes), and CD14 (LPS receptor). Activated immune cells ($CD8^-CD25^+$) were greater ($P = 0.05$) in electrolyte+DFM calves compared to electrolyte and negative control calves. L-selectin expression on leukocytes ($CD8^-CD62L^+$) was greater ($P = 0.05$) in calves on either electrolyte treatment compared to negative control calves. Electrolyte+DFM calves had a greater ($P = 0.05$) γδ T cell population ($CD8^-TCR^+$) compared to electrolyte and negative control calves. Calves provided the electrolyte treatment had a greater ($P = 0.05$) cytotoxic memory T cell ($CD8^+CD45RO^+$) population than the negative control calves; whereas, the electrolyte+DFM calves

showed an intermediate response between the two. The proportion of activated γδ T cells ($TCR1^+AM\text{-}2^+$) was greater ($P = 0.05$) in electrolyte+DFM calves compared to electrolyte and negative control calves. Monocytes expressing LPS ($CD172a^+CD14^+$) did not differ on d 3, 7, 21, and 42 post-placement, but on d 28 this population was lower ($P = 0.07$) in electrolyte+DFM calves compared to negative control calves (treatment x day interaction, $P = 0.10$). The results of this study indicate that supplementation with a *Bacillus*-based DFM at the incidence of scours has the potential to enhance innate and adaptive immune development in calves.

Key Words: Probiotic, Immunity, Bovine

466 Effects of an immunostimulatory feed additive on neutrophil function and development of titer in ruminant livestock. N. E. Forsberg*[1,3], Y. Wang[3], S. Puntenney[3], and J. Burton[2], [1]*Oregon State University*, *Corvallis*, [2]*Michigan State University*, *East Lansing*, [3]*OmniGen Research*, *Corvallis, OR*.

OmniGen-AF increases expression of molecular markers of innate immunity. These markers include neutrophil L-selectin, interleukin-1B and interleukin-8R. Ability of this product to augment expression of markers has been noted particularly in animals which have been immunosuppressed. Goals were to determine whether changes induced by the product at the molecular level translated into changes in neutrophil function and in development of titer against a vaccination program. In the first study, immunosuppressed sheep (0.1 mg Azium/hd/d) were fed either a control ration or a ration containing OmniGen-AF (5 g/d) for 31 d. At the end of the study, blood samples were recovered and neutrophils were purified using a Percoll gradient. Phagocytosis and respiratory burst assays were completed using commercial ELISA kits. In the second study, Angus cattle (275 kg) were assigned to one of three diets (0, 15 and 30 g/hd/d of OmniGen-AF). Calves were vaccinated with the Pfizer J5 E. coli vaccine on d 7, 21 and 35 and J5 titer was assessed within IgM, IgG1 and IgG2 fractions at d 56. Beginning on d 56 all animals were placed on the control diet and titer was again assessed on d 82. Neutrophils recovered from immunosuppressed sheep displayed enhanced function. Phagocytosis was increased ($P<0.01$) by 40% and respiratory burst activity was increased 2-fold ($P<0.01$). In growing cattle no differences in J5 titer were detected within the IgM fraction. At d 56, the additive did not affect ($P>0.05$) J5 titer in the IgG1 fraction; however, J5 titer in the IgG2 fraction was elevated 2-fold ($P<0.05$) in the animals fed 30 g/head OmniGen/d. At d 82, J5 titer in control-fed animals had declined to levels which were similar to those on d 0; however, animals which had been fed OmniGen-AF at the 15g or 30g levels had elevated J5 titer ($P<0.05$) in the IgG1 fraction. No differences ($P>0.05$) in J5 titer within the three experimental groups were noted in the IgG2 fraction on d 82. Anecdotal reports indicate benefit of the OmniGen-AF product for herd health. Enhanced neutrophil function and enhanced responses to vaccination programs may underlie these reports.

Key Words: Immunity, OmniGen-AF, Titer

467 Induction Of proinflammatory cytokines and constitutive expression Of Nramp1 in bovine blood neutrophils after exposure to *E. coli* endotoxin (LPS). A. Morris*, Z. Liu, and M. Worku, *North Carolina Agricultural and Technical State University*, *Greensboro*.

The pattern of constitutive and inducible expression of genes associated with the inflammatory response is important in defining innate (natural) resistance/susceptibility to diseases. Natural Resistance Associated Macrophage Protein1 (Nramp1) is expressed in macrophages and polymorphonuclear leukocytes. Studies have shown that Nramp1 is critical for resistance to several diseases. Mutations in Nramp1 are associated with increased disease susceptibility. Human polymorphonuclear leukocytes (PMN) are the major site of Nramp1 expression, followed to a lesser degree by monocytes (MN). Expression of Nramp1 by bovine PMN and the effect of mediators of inflammation such as *E. coli* endotoxin (LPS) have not been defined. The objectives of this study were to evaluate the expression of Nramp1 mRNA and determine how Nramp1 expression is regulated in bovine blood PMN upon LPS stimulation. Bovine blood PMN were isolated from three clinically healthy Holstein Friesian cows. The PMN were then incubated (37°C, 5% CO2, 15 min) in the presence or absence of LPS (100ng). Control cells were maintained in phosphate buffered saline (PBS). RNA was then isolated using Tri reagent (SIGMA) and the quality and quantity of RNA was determined using a Bioanalyzer (Agilent). Isolated RNA (600ng) was used to prepare cDNA (Ambion-Retroscript). Specific primers for Nramp1, IL-1β, IL-8 and GAPDH as loading control were used for RT-PCR. Nramp1 was constitutively expressed in both LPS and PBS treated bovine PMN. There was an induction of IL-1β and IL-8 genes upon LPS stimulation. These results indicate that Nramp1 is constitutively expressed in bovine blood PMN. No further up regulation was observed by exposure to LPS (100 ng) for 15 min. However this dose and time of exposure was sufficient to induce the transcription of the proinflammatory cytokines like IL-1β and IL-8. Variation was observed in the levels of gene expression between cows. Further studies will fine tune the response to activation by LPS.

Key Words: Polymorphonuclear Neutrophils, Nramp1, LPS

468 Growth performance and immunocompetence of heat stressed broilers fed different sources of dietary fatty acids. M. O. Smith*[1] and J. R. Bartlett[2], [1]*University of Tennessee*, *Knoxville*, [2]*Tuskegee University*, *Tuskegee, AL*.

One hundred and forty four male broilers were used to evaluate the effects of two sources of fatty acids on growth and immune competence of heat stressed broilers. Four replicate groups of twelve chicks each were assigned to three dietary treatments consisting of a basal diet supplemented with corn oil, fish oil (menhaden), or fish oil plus zinc and raised in battery brooders. On day 22, chicks were transferred to either a thermoneutral, TN (23.9 C) or a heat stress, HS (23.9 - 35 C, diurnal cycling) environmental chamber. Humoral immunity was assessed by injecting birds intravenously with 1 mL of 7% sheep red blood cell suspension followed by evaluation of sera for total, mercaptoethanol-resistant (ME-R), and mercaptoethanol-sensitive (ME-S) antibody titers. Cell-mediated immunity was assessed by using a sephadex stimulation method to recruit and harvest abdominal exudate cells (AEC), and phagocytic ability of macrophages determined. On day 50, birds were weighed, slaughtered, and thymus, spleen, liver, and bursa of Fabricius collected and weighed. Sources of dietary fatty acids did not impact growth, however, HS birds consumed 11% less feed and gained 8% less weight than TN birds. Bursa and thymus weights were reduced by 23% and 24% respectively in HS birds but diets had no effect. Number of AEC and incidence of macrophages were not affected by fatty acid source but the percent phagocytic

macrophages decreased under HS. Total ME-S (IgM) and ME-R (IgG) antibody titers were highest (P< 0.03) for fish oil + Zn while total and IgM titers were reduced (P<0.01) by HS. Results indicate that feeding fish oil can assist birds to mount an effective immune response during HS.

Key Words: Heat stress, Broiler, Immunocompetence

469 Immunopathology and cytokine responses in broiler chickens coinfected with eimeria maxima and clostridium perfringens using an animal model of necrotic enteritis. H. S. Lillehoj*[1], S. S. Park[1], P. C. Allen[1], S. FitzCoy[2], and D. A. Bautista[3], [1]*U.S. Department of Agriculture-ARS*, *Beltsville, MD*, [2]*Schering-Plough Animal Health*, *Millsboro, DE*, [3]*University of Delaware*, *Georgetown*.

The incidence of necrotic enteritis (NE) due to Clostridium perfringens (CP) infection in commercial poultry has been increasing at an alarming rate. While pre-exposure of chickens to coccidia infections is believed to be one of the major risk factors leading to NE, the underlying mechanisms of CP virulence remain undefined. The objectives of this study were to utilize an experimental model of NE produced by Eimeria maxima (EM) and CP coinfection to investigate the pathological and immunological parameters of the disease. Broilers coinfected with EM plus CP exhibited more severe gut pathology compared with animals given EM or CP alone. Additionally, EM/CP coinfection increased the numbers of intestinal CP bacteria compared with chickens exposed to an identical challenge of CP alone. Coinfection with EM and CP repressed nitric oxide synthase gene expression that was induced by EM alone, leading to lower plasma NO levels. Intestinal expression of a panel of cytokine and chemokine genes following EM/CP coinfection showed a mixed response depending on the transcript analyzed and the time following infection. In general, IFN-α, IFN-γ, IL-1β, IL-2, IL-12, IL-13, IL-17, and TGF-β4 were repressed, while IL-8, IL-10, IL-15, and LITAF were increased during coinfection compared with challenge by EM or CP alone. These results are discussed in the context of EM and CP to act synergistically to create a more severe disease phenotype leading to an altered cytokine/chemokine response than that produced by infection with the individual pathogens.

Key Words: Necrotic Enteritis, Clostridium Perfringens, Eimeria Maxima

470 Intestinal cytokine responses to Salmonella enterica serovar typhimurium infection in young chicks. Y. O. Fasina*[1], P. S. Holt[2], E. T. Moran[1], R. W. Moore[2], D. E. Conner[1], and S. R. Mckee[1], [1]*Auburn University*, *Auburn, AL*, [2]*USDA-ARS Egg Safety & Quality Research Unit*, *Athens, GA*.

Vaccination has been proposed as one of the best ways to control Salmonella infection in poultry. Cytokines are essential effector molecules for innate immunity and have been proposed as adjuvants that can improve efficacy of vaccines. Thus, we designed an experiment to determine the effect of Salmonella typhimurium (ST) infection on the expression of selected pro-inflammatory cytokines (IL-1, IL-6, IFNy) and IL-10 (an anti-inflammatory cytokine) in the intestine of chicks. A 14-day experiment was conducted using 112 day-old chicks. Chicks were randomly allocated to 2 treatments; treatment 1 (CN) consisting of chicks that were not challenged with ST, and treatment 2 (STC) consisting of chicks that were challenged with ST at 4 days of age. Chicks were fed a corn-soybean meal diet. On days 4 and 9 post-challenge (PC), intestinal ST levels were enumerated on XLT4 agar. On days 5 and 10 post-challenge, intestinal tissue samples were collected (from jejunum, ileum and cecum) and analyzed by quantitative Reverse Transcriptase-Polymerase Chain Reaction (RT-PCR) procedure to determine the level of expression of cytokine genes. CN chicks remained ST-free throughout the experiment. Intestinal level of ST in STC chicks was 4.05 ± 3.30 log10 CFU at 4 days PC, indicating that ST challenge was successful. Expression levels (mRNA levels) of the pro-inflammatory cytokines were higher in STC chicks compared to CN chicks in all tissues. Specifically, at 10 days PC, jejunal fold change in mRNA was highest ($p < 0.05$) for IL-6 (2.62). Also, cecal fold change in mRNA was highest ($p < 0.05$) for IL-1 (1.71). In all tissues, IL-10 had the lowest mRNA levels. It was concluded that ST infection induced an inflammatory immune response characterized by increased expression of proinflammatory cytokines (IL-1, IL-6, and IFNy).

Key Words: Salmonella Typhimurium, Pro-inflammatory Cytokines, Broiler Chicks

471 Comparative expression of activin receptor type IIB in bovine peripheral blood mononuclear cells. S. Tanaka*, S. Hayashi, Y. Taketa, M. Miyake, K. Watanabe, S. Ohwada, H. Aso, and T. Yamaguchi, *Laboratory of Functional Morphology, Graduate School of Agricultural Science, Tohoku University*, *Sendai, Japan*.

Myostatin, a member of the transforming growth factor-β (TGF-β) superfamily, acts mainly as a negative regulator of skeletal muscle mass through the signal transduction of activin receptor type IIB (ActRIIB). Double-muscled (DM) cattle with mutations of myostatin gene result in a marked muscle hypertrophy. TGF-β1 is a critical factor in regulation of T cell-mediated immune responses and in the induction of immune tolerance. In addition, Activin A, which belongs to the same TGF-β superfamily member as myostatin, is involved in inflammatory responses. These findings indicate that myostatin may be related to immune responses. The present study was conducted to investigate the comparative expression of ActRIIB in bovine peripheral blood mononuclear cells (PBMC). The peripheral blood was collected from Holstein cattle (n=3). PBMC were prepared by density gradient centrifugation using Lympholite-H, and T cells, B cells and monocytes were isolated by magnetic cell sorting (MACS) method. Total RNA was extracted from MACS-isolated T cells, B cells and monocytes and the mRNA expression of ActRIIB was analyzed by PCR method with bovine specific primers. Furthermore, ActRIIB positive cells in PBMC, T cells, B cells and monocytes were analyzed by flow cytometry using anti-bovine CD3, anti-bovine BB2, anti-bovine CD14 and anti-human ActRIIB antibodies. The ActRIIB mRNA was expressed in T cells, B cells and monocytes but less in B cells. The ActRIIB positive cells in PBMC were 31.0±3.9%. The percentages of ActRIIB positive cells were 48.0±3.4%, 24.1±2.0% and 53.47±4.7% in T cells, B cells and monocytes, respectively. Thus, ActRIIB was preferentially expressed in T cells and monocytes. These results strongly suggest that myostatin primarily acts on T cells and monocytes, and regulates the function of their cell types to mediate immune responses in cattle.

Key Words: Activin receptor type IIB, Lymphocytes, Bovine

Joint National Extension Workshop: Accountability Issues in Extension: Identifying, Measuring and Reporting Impacts

472 Introduction and Washington update. R. D. Reynnells*, *USDA/CSREES/PAS*, *Washington, DC*.

Presentations in this first of two Joint National Extension Workshops (Dairy, Poultry and Animal Science) address accountability issues (identify, measure, and report). Administrators and those who market Extension to decision makers will detail our responsibilities to create and maximize benefit from reports of accomplishment, and how this information is used to promote Extension programs at the state and Federal levels. The value of Extension is understood by many stakeholders. Extension personnel may feel their value is intuitively obvious and that decision makers do not appreciate their value and dedication to our food production systems and society. To be recognizable and have the potential for being appreciated, Extension's impact must be transmitted to administrators, legislators, and other decision makers and society. Discussions will include how impact reporting is used at the college level and how Federal reports are generated, tips on effectively communicating achievements through multiple uses of information, along with how funding support may be enhanced by impact statements. Promotion of Extension requires evaluation based information generated by county and state level personnel. The desire of faculty to create reports is enhanced by their recognition that the information is used by Federal and other officials in decision making and the marketing of extension. A successful documentation and reporting model for Extension will be presented. The Special Recognition Award for Poultry Extension faculty is presented to Casey Ritz, University of Georgia. The 2007 Farm Bill, and how we address animal welfare issues (e.g., Animal Welfare Assessment Contest; Future Trends in Animal Agriculture) will be discussed. Budgetary constraints have reduced direct involvement in multi-state research committees and participation in other important meetings. The 2008 National Poultry Waste Management Symposium Coordinator is Casey Ritz, University of Georgia. The PSA Support Personnel Award leadership has been transferred to the committee chair, which now will change each year as is done for other awards committees.

Key Words: Accountability, Extension, Impact Reporting

473 Accountability for administrators—impacts with impact. B. D. Moser*, *The Ohio State University*, *Columbus, OH*.

While Extension has been improving lives for 90 years, there is a necessity for greater accountability of efforts more than at any other time in our history. It is only through a focused, concerted effort to better identify and leverage these defined impacts that Extension will continue to thrive through the 21st century. At the college/university level, these impact data have far-reaching influences on: internal annual specialist evaluations by administrators; inclusion in the Promotion & Tenure process; more successful grant proposal applications and funding; measuring trends; identifying future programming needs and opportunities; media releases; and effectively communicating with our community leaders, stakeholders, state legislators, congressional leaders and county commissioners. Just as important, this information provides the important documentation and programmatic justification needed to provide comprehensive data in compliance with annual federal reporting requirements. At OSU, we utilize a Logic Model in a web-based Extension and Research planning and reporting system, which combines defined program development and evaluation to identify impacts. Through program development, the change (outcome/impact) needed is identified (knowledge, skills, attitudes, behavior, economic impact). Programs and participation are then needed to manifest this change (activities/outputs). Finally, resources (inputs) to create and conduct the programs result in impacts (outcomes). To ensure the success of this Logic Model, it is important that all Extension specialists and programming leaders recognize and embrace the long-term benefits of adequately describing, documenting and reporting outcomes/impacts. Most specifically, the result of well-written impact statements often lead to increased support and funding opportunities.

Key Words: Accountability, Extension, Impacts

474 What information do I need to keep Extension funded? J. C. Wade*, *National Association of State Colleges and Land Grant Universities*, *Washington, DC*.

Cooperative Extension is a partnership among federal, state and local agencies that works to provide research-based information to agricultural and other producers and to consumers and ordinary citizens. Funding such a complex organization requires national and local strategies that combine the substantial human resources from across the nation into a coherent strategy with a limited number of goals, but high expectations. NASULGC helps to coordinate a multifaceted strategy. Mostly volunteer supporters of the Land-Grant Universities are teamed to garner the best for support of the System among public policy makers and stakeholders from across the country. Linking to this well informed support group is paramount to continued funding. NASULGC-based committees and task forces work to find these successes. Success requires strategies directed at both legislators and agency personnel. This presentation will review the status of FY2007 and FY2008 Federal appropriations and the 2007 Farm Bill.

Key Words: Cooperative Extension, Funding, Policy

475 How plans of work and annual reports are used at the federal level. B. Hewitt*, *Cooperative State Research Education Extension Service*.

This session presents a quick overview of the ways in which data from the State Plans of Work (POWs) and annual reports have and will be used to meet Federal planning and accountability requirements. In addition to serving as reports to National Program Leaders (NPLs) within CSREES to help them in planning future work, CSREES uses data from the POWs and annual reports to address Federal requirements. These requirements include the President's Management Agenda (PMA), Budget-Performance Integration (BPI), and the

requirements for the Office of Management and Budget (OMB) for the Program Assessment Rating Tool (PART) and Research and Development Investment Criteria. To meet these internal and external needs, CSREES developed a self-assessment and peer review process known as the Portfolio Review Expert Process (PREP). This session will review the relationships among the PREP, PART, and BPI. It will also describe the ways that government performance information is presented by OMB to the public.

Key Words: Budget, Plans of work, Performance

Nonruminant Nutrition: Lessons and Logistics of Application of Digestible Amino Acids in Diet Formulation

476 Amino acid digestibility measurements of feedstuffs – Lessons from poultry studies. V. Ravindran*[1] and W. L. Bryden[2], [1]*Massey University*, *Palmerston North, New Zealand*, [2]*University of Queensland*, *Gatton, Australia*.

It is now accepted that the analysis of ileal contents rather than of excreta is a more reliable method for assessing amino acid (AA) digestibility of feedstuffs for poultry. However, a major problem faced by the users of currently available digestibility databases is the confusion that exists about various terminologies used to describe AA digestibility, highlighting the need in the industry to agree on a standard methodology to measure and describe AA digestibility estimates. Lessons learnt from ileal digestibility assays, which were developed in our Laboratory for a large-scale survey of poultry feedstuffs, will be discussed and a standard mehodology for poultry digestibility assays will be presented. The relative merits of apparent and true digestible AA systems, however, will continue to be a subject of debate among nutritionists. The measurement of true digestibility includes a correction for endogenous AA secretions determined in the same digestibility assay. The concept of standardized digestibility system that overcomes the limitations of apparent and true digestible AA systems will be discussed. This system is comparable to true digestibility system, with the only difference being that it involves a correction for basal endogenous losses that need not be determined in the same digestibility assay. The basal endogenous AA loss is defined as the minimal loss of endogenous AA which occurs irrespective of feed ingredient or dietary composition and could be measured by feeding of low levels of highly digestible proteins (e.g. casein, wheat gluten) or the regression method. However, only limited published data is available on the endogenous amino acid losses at the distal ileum of poultry. Since the transformation to standardized digestibility values will require reliable estimates of basal endogenous amino acid losses at the ileal level, further research on this subject is warranted. Some key areas for future research will be highlighted.

Key Words: Amino Acid Digestibility, Endogenous Losses, Poultry

477 Methodology for endogenous flow estimates for standardization of digestible amino acids. S. A. Adedokun*[1], O. Adeola[1], C. M. Parsons[2], M. S. Lilburn[3], and T. J. Applegate[1], [1]*Purdue University*, *West Lafayette, IN*, [2]*University of Illinois*, *Urbana/Champaign*, [3]*The Ohio State University*, *OARDC Wooster*.

The importance of formulating poultry diets on a digestible amino acid basis cannot be over emphasized based on the need to reduce safety margins associated with diet formulation, especially when diets are formulated on a total amino acid basis. In addition to the undigested and unabsorbed amino acids of dietary origin, amino acids of endogenous origin which can either be basal or diet specific are also found in ileal digesta. Hence there is the need to standardize apparent digestibility coefficients. The improvement in techniques used in amino acid analysis as well as a shift from excreta sampling to ileal digesta has resulted in more accurate amino acid digestibility coefficients. Despite this, however, it is important to determine the relative amino acids in the digesta that are of endogenous origin. Although the need for standardization and the associated advantages of standardized values is still subject to debate it is however, important to evaluate how values from various methodologies compare. Several methods have been used for standardizing digestibility coefficients. A number of methods have been used to estimate ileal endogenous amino acid (IEAA) flow. These include the classical methods comprising of the regression method, the use of nitrogen-free diet (NFD), and fasted roosters. The criticisms with the last two methods are that the animal is not in a physiological state and the IEAA flow is underestimated. Other methods include feeding of completely digestible protein (CDP), peptide alimentation ultrafiltration techniques (enzymically hydrolyzed casein), the use of isotope markers, and the homoarginine technique. Different methods have resulted in different endogenous flow estimates with NFD method having the lowest values when compared with flows from the regression and CDP methods. In addition to the influence of methods on IEAA flows, the influence of age on flow is also important. For example, IEAA flow has been shown to decrease by about 50% between d 5 and d 15 in broiler chicks.

Key Words: Amino Acid, Endogenous Flow, Poultry

478 Ileal digestibility of amino acids: Lessons from pig studies. O. Adeola*, *Purdue University*, *West Lafayette, IN*.

It is recognized that only a part of the dietary amino acid supply is digested, absorbed, and utilized by animals. Ileal amino acid digestibility is considered the best measure of the amino acid value of feed ingredients. Formulation of broiler chicken diets on a digestible amino acid basis should greatly reduce feed cost and nitrogen emissions from broiler operations, decrease safety margins, and increase the accuracy of predicting performance and the uniformity of product after processing. An important component is accurate datasets on ileal digestibility of amino acids in feed ingredients. Generating the datasets on ileal amino acid digestibility values require quantifying the disappearance of ingested amino acids from the gastrointestinal tract immediately anterior to the ileocecal junction. Ileal amino acid digestibility values may be expressed as apparent ileal digestibility, which is the proportion of amino acid ingested that is not accounted

for in the total ileal outflow of amino acids and emphasizes that the outflow contains amino acids of both dietary and endogenous origins. Total ileal outflow of amino acids therefore consists of unabsorbed dietary amino acids and those of endogenous origin secreted into the gastrointestinal tract that were not absorbed prior to exit from the ileum into the ceca. Ileal outflow of amino acids of endogenous origin consists of basal outflow that is not dependent on feed ingredient composition and specific outflow, which is ingredient composition dependent. Thus, ileal digestibility values may be also expressed as standardized ileal digestibility or true ileal digestibility, which reflect the correction of the apparent ileal digestibility for basal or specific ileal outflow of amino acids, respectively. There is evidence from swine literature that standardized ileal amino acid digestibility values are more likely to be additive in mixtures of feed ingredients and research is needed for a variety of feed ingredients to confirm that this also holds in broiler chickens.

Key Words: Amino Acids, Digestibility, Ileal Flow

479 Digestible amino acid formulation of poultry feeds; practical considerations. D. J. Burnham*, *Aviagen, Inc*, *Huntsville, AL*.

Poultry Feed Formulation has evolved from an Art more toward a Science over the past forty years. Sound nutrition research and computing technology has developed alongside analytical techniques to allow us to refine our formulation techniques. Digestible amino acid formulation is part of the science. Unfortunately, there is still a lot of Art since as an industry we are not yet fully utilizing the all of the Science that is available to us today. The United States Poultry Industry has up until recently been extremely fortunate with an abundant supply of high quality inexpensive ingredients. So, the pressure to make full use of the science has not been there. This does not however mean that this is the best or most profitable approach. There are a number of feed ingredients that have very variable digestibilities; these include, meat and bone meal, poultry by product meal, feather meal, distillers grains and solubles and others. Any ingredient that undergoes processing, primarily heat treatment, stands the risk of being damaged. Formulating on a total basis ignores these effects, and will vastly over value a poor ingredient or undervalue a well processed ingredient. Ingredient buyers are charged with buying ingredients at the lowest price, not the best value. In addition, the most limiting amino acids are now commercially available in synthetic form, these are 100% digestible. Evaluating their value when formulating on a total basis undervalues thevalue by at least 10%, as the assumption is that all other ingredients are 100% digestible. The most common reason given for not formulating on a digestible basis is that we do not have accurate digestibility values. The truth is that the values may be a few points out, but using an 85% digestibility coefficient when it is actually 87%, is a lot more accurate than assuming it is 100%. Indications are that the status quo is changing as bio-fuels compete for the same resources. The products we may have to use vary in digestibility more than current ingredients and we need to make sure we understand how to use them to optimize performance and maximize profitability of our operations.

Key Words: Digestible, Amino Acids, Poultry

Nonruminant Nutrition: Poultry Nutrition - Enzymes, Feeds, Feed Ingredients, and Manufacturing

480 Influence of prepress solvent extracted cottonseed meal supplemented with exogenous enzyme and digestible lysine on performance, digestibility, carcass and immunity responses of broilers chickens. T. Mushtaq*[1], M. Sarwar[1], G. Ahmad[1,2], M. A. Mirza[1], and U. Noreen[1], [1]*University of Agriculture*, *Faisalabad, Pakistan*, [2]*Shamim Feed Industries*, *Bahawalpur, Pakistan*.

The response of broiler chickens to 2 levels of endo-1,4-β xylanase (EC 3.2.1.8) and endo-1,3-β glucanase (EC 3.2.1.6) combination (with and without), 3 levels of digestible lysine (0.8, 0.9 and 1.0% with the applicability of ideal protein concept) and 2 levels of cottonseed meal (CSM; 20 and 30%) were evaluated in $2 \times 3 \times 2$ factorial arrangement. A total of 2448 male Hubbard broiler chicks were fed on the practical vegetable based mash diets having 2750 kcal ME/kg and 18.50% CP from 1 to 42 d of age. The supplemental enzyme had minimum 1,100 units of endo-1,4-β xylanase and 100 units of endo-1,3-β glucanase kg-1 of finished diet. The addition of CSM at 30% resulted in increased arginine to lysine ratio. The CSM at 30% depressed BW gain and mortality during 1 to 21 d and BW gain and feed:gain during 1 to 42 d. A depression in dressing and breast percentages were also observed by the addition of 30% CSM. The digestible lysine at 1.0% depressed the BW gain and lowered the mortality during 1 to 21 d whereas the BW gain and feed:gain were unaffected among the three digestible lysine levels. The antibody titers against Newcastle and infectious bursal disease viruses were improved with the increasing levels of digestible lysine. The enzyme supplementation improved the AME and digestibility coefficient of nitrogen when it was used with 30% CSM. No effect of enzyme, lysine, CSM or their interactions was observed on serum iron, gizzard and liver weights or abdominal fat percent. In conclusion, the enzyme supplementation failed to show any improvement in performance in CSM based diets and increasing digestible lysine in such diets did not improve the growth performance and carcass characteristics probable due to high arginine contents.

Key Words: Cottonseed Meal, Enzyme, Digestible Lysine

481 Growth, carcass nutrients accretion and nutrient retention of broiler chicks receiving phytate- or polysaccharides-degrading enzymes. O. A. Olukosi*[1], A. Cowieson[2], and O. Adeola[1], [1]*Purdue University*, *West Lafayette*, [2]*Danisco Animal Nutrition*, *Marlborough, Wiltshire, UK*.

Broiler chicks were used to determine efficacy of a cocktail of xylanase, amylase and protease (XAP) or phytase for enhancing growth, carcass nutrient accretion and total tract nutrient retention. Carcass nutrient accretion from 0 to 21 d post hatch was determined using comparative slaughter technique. Thirty chickens were used as initial slaughter group. Four hundred and fifty chickens were allocated to 5 treatments in a randomized complete block design; each treatment had 6 replicate cages with 5 birds per replicate cage. The treatments were: (1) positive

control (PC) with adequate P and ME; (2) negative control (NC) marginal in P and ME; (3) NC plus phytase at 1,000 FTU/kg; (4) NC plus XAP added at 650, 1,650 and 4,000 U/kg of xylanase, amylase and protease, respectively; and (5) NC plus phytase and XAP at levels in 3 and 4, respectively. The diets were corn-soybean meal based with wheat as a source of non-starch polysaccharides. Phytase alone or combined with XAP improved ($P < 0.05$) all of the growth response criteria; XAP alone did not improve any of these response criteria; there were no phytase×XAP interaction. Phytase alone or combined with XAP improved ($P < 0.01$) carcass ash accretion. Phytase alone or combined with XAP improved ($P < 0.05$) carcass DM, fat and protein accretion, there was no phytase×XAP interaction for the nutrients accretion. Phytase improved ($P < 0.05$) ME, DM and P total tract retention; XAP improved ($P < 0.05$) Ca and tended to improve ME and total tract DM retention. There was phytase×XAP interaction ($P < 0.05$) only for P retention. Phytase combined with XAP improved ($P < 0.05$) retention of DM, P and Ca and ME above NC treatment. In conclusion, combination of phytase and XAP improved growth performance, carcass nutrients and ash accretion and total tract nutrients retention in broilers receiving corn-soybean meal diet marginally deficient in P and ME containing added wheat.

Key Words: Broilers, Carcass Composition, Enzymes

482 Nutritional evaluation of new corn distillers dried grains with solubles (DDGS) produced by the enzymatic milling (E-Mill) and elusieve processes. E. Kim*, C. Parsons, V. Singh, and R. Srinivasan, *University of Illinois*, *Urbana*.

Ethanol production is expected to greatly increase in the next five years and in response to this increase, new processes are being developed to maximize ethanol production from corn and to create new, more highly marketable corn distillers dried grains with or without solubles (DDGS or DDG, respectively). This current study evaluated coproducts produced from two different modified processes, the enzymatic milling (E-mill) and the Elusieve process. The E-mill process subjects the corn kernel to enzymes that hydrolyze starch and aids in removing the germ, pericarp, and endosperm prior to fermentation. The Elusieve process utilizes sieving the finished coproduct, DDGS, and then elutriating with air to remove fiber from the DDGS samples. To nutritionally evaluate the products produced from these new processes, a precision-fed rooster assay using cecectomized roosters was conducted to determine TME_n and amino acid digestibilities. When the E-mill DDG was compared to a conventionally processed DDGS, there was a large increase in protein content from 29.9 to 56.4%. The TME_n of the E-mill DDG was significantly increased by more than 10% compared to the conventional DDGS and amino acid digestibility coefficients for the E-mill DDG were significantly increased by 7 to 10 percentage units for most of the amino acids. When DDGS was subjected to the Elusieve process, the resulting DDGS had increased protein content and TME_n, particularly when high air velocities were used. The most effective Elusieve treatment increased the protein content from 29.9 to 37.2% and increased the TME_n by approximately 7%. The results of this study indicate that the Elusieve and E-Mill processes can be used to enhance the nutritional value of DDGS for poultry.

Key Words: Modified Distillers Dried Grains With Solubles, Processing Technologies, Precision-Fed Rooster Assay

483 Phytase in ethanol production process improves nutritive value of DDGS. M. Hruby*[1], J. K. Shetty[2], G. Chotani[2], T. Dodge[2], and C. N. Coon[3], [1]*Danisco*, *St. Louis, MO*, [2]*Genencor*, *Palo Alto, CA*, [3]*University of Arkansas*, *Fayetteville*.

A study was conducted to evaluate the effect of phytase treatment in different ethanol production processes, i.e conventional hot cook and Granular Starch Hydrolyzing Enzymes (GSHE) process on the nutritive value of distillers dried grains with solubles (DDGS). The samples were analyzed for dry matter, oil, starch, rate of starch digestion (RSD), crude protein, NDF, ADF, crude fiber, ash, sugar, total phosphorus and phytate phosphorus. Each DDGS sample was precision-fed to market-age broilers and total excreta collection was conducted during 48 hours after DDGS feeding. Almost no phytate P was detected in DDGS samples from the phytase-containing ethanol processes. DDGS derived from the phytase treatment had significantly higher true metabolizable energy (TME) and digestibility of some amino acids.

Key Words: Phytase, Ethanol Process, DDGS Digestibility

484 Effects of mega doses of phytase on broiler chick body composition. J. Puttress*[1], W. W. Saylor[1], R. Angel[2], A. D. Mitchell[3], and M. E. Persia[1], [1]*University of Delaware*, *Newark*, [2]*Unviersity of Maryland*, *College Park*, [3]*USDA*, *Beltsville, MD*.

Phytate is found in seed-based feedstuffs and can bind, among others, Ca, trace minerals and possibly starch and protein reducing bioavailability of these nutrients. New evidence suggests that phytate has additional antinutrient properties. Phytase hydrolyzes P bound to phytate increasing phytate P utilization and reducing the antinutritional effects of phytate. An experiment was conducted to determine the effects of mega doses of phytase on body composition of chicks fed adequate nonphytate P (nPP). There were five experimental treatments including a control diet (0.45% nPP) and the same diet supplemented with 500, 7500 and 15000 FTU of OptiPhos™ (an E. coli phytase; EP), and 15000 FTU of Ronozyme™ (a fungal phytase; FP). Each treatment was fed to eight replicate groups of eight male Ross 308 chicks from 8 d to 22 d. On d 22, the chicks were euthanized and frozen for dual energy X-ray absorptiometry (DXA) scanning before being ground for wet chemistry body composition analysis. Ground carcass samples were lyophilized and freeze ground for crude protein, crude fat, and ash determination. Phytase supplementation did not affect DXA lean or fat tissue accumulation, but all levels of phytase increased body mineral content over the control diet (10.11 to 10.60 g/chick v. 8.74 g/chick; $P = 0.0007$). Wet chemistry analysis showed increased crude protein of carcasses from chicks supplemented with 15000 FTU of FP compared to 15000 FTU of EP (338 v. 285 g protein/chick; $P = 0.0097$). Total carcass crude fat was increased in birds fed 15000 FTU of phytase compared to all other treatments (167 and 168 v. 151 to 155 g fat/chick; $P=0.0024$). Supplementation of birds with 7500 FTU of EP resulted in increased total carcass ash compared to birds supplemented with either 500 FTU of EP or 15000 FTU of PF (53.5 g ash/chick v. 46.1 and 44.0 g ash/chick; $P = 0.0459$). Supplementation of broiler diets with mega doses of phytase can alter chick body composition of birds fed adequate dietary nPP.

Key Words: Phytase, Body Composition, DXA

485 The effect of genotype and choice-feeding on organically-reared broilers fed diets devoid of synthetic methionine. A. L. Rack*, N. P. Buchanan, J. M. Hott, S. E. Cutlip, and J. S. Moritz, *West Virginia University*, *Morgantown*.

In light of the impending ban on synthetic methionine in organic poultry diets, researchers have focused on finding alternative strategies to supply this amino acid. The objectives of this study were two-fold: 1) to assess performance and carcass characteristics of a slow-growing and fast-growing broiler genotype fed diets devoid of synthetic methionine and 2) to determine performance and carcass quality effect, of choice-feeding. Inclusion of fish meal and high percentages of soybean meal enabled the specific genotype methionine requirement to be met. All diets were certified organic. Slow-growing broilers (Gourmet Black) were raised from 1-83 days, and fast-growing broilers (Cobb 500) were raised from 1-54 days. One hundred fifty birds from each genotype were reared indoors during the starter period. The broilers were transferred at the end of the starter period to houses located on the West Virginia University certified organic farm. Broilers had access to pasture for at least eight hours daily, and were exposed to natural fluctuations of environmental conditions. Choice or no choice feeding management was implemented in the grower and finisher periods. Choice-feeding management was defined as providing one feeder of ground corn and one feeder of the remaining complete diet ingredients in each pen. No choice-feeding management was defined as providing two feeders of complete diet in each pen. Birds on no choice management showed higher LWG ($p \leq 0.05$) compared to choice managed birds. Slow-growing broilers had higher FCR ($p \leq 0.05$) than the fast-growing genotype. Slow-growing birds also had lower breast yield ($p \leq 0.05$), than the fast-growing genotype. The fast-growing no choice birds had higher breast yield than the choice birds of the same genotype ($p \leq 0.05$). Fast-growing genotypes were superior in performance and carcass characteristics. Choice-feeding management did not improve performance and carcass characteristics.

Key Words: Synthetic Methionine, Organic, Broilers

486 Meat meal extract as a risk factor for the development of heart failure in fast growing commercial broilers. S. Nain*, B. Laarveld, and A. A. Olkowski, *University of Saskatchewan*, *Saskatoon, SK, Canada*.

The etiologies of heart failure in laboratory animals and humans have been found to be associated with thermal food processing. Cooked meat contains a number of mutagenic heterocyclic amines and other compounds which have been shown to produce cardiomyocyte necrosis and myofibrillar degeneration. It is likely that heterocyclic amines also are present in broiler diets because meat meal (MM) and fish meal are commonly included after rendering at high temperature. Our objectives were to evaluate whether compounds present in MM are associated with risk of heart failure in broilers. Extract from MM was obtained by extracting commercial product with acidified methanol at a ratio 1:4 (wt/vol). The treatment and control diets were prepared by mixing the condensed MM extract or placebo (condensed extraction medium) with commercial broiler feed. A total of 238 birds were randomly allocated to two groups (control and treatment) with 3 replications per group. The birds were housed in raised perforated floor pens in an environmentally controlled room. Feed and water were provided ad libitum. The temperature during the first 7 days was maintained at 34°C followed by a gradual decrease to a level approximately 30% lower than that set for normo-thermal brooding. Broilers fed diet spiked with MM extract showed a higher incidence ($P \leq 0.05$) of ascites (73.9%) vs the control group (62.2%). Also the incidence of sudden death syndrome tended to be numerically higher in the MM treatment group (6.7%) vs the control group (5.9%). Post mortem examination revealed that broilers fed diet containing MM extract showed a higher frequency of cardiac lesions such as ventricular dilation, valve degeneration, and pericardial effusions. The severity of the lesions was more pronounced ($P \leq 0.05$) in the group fed the diet with MM extract. We conclude that methanol soluble factors present in MM precipitate patho-physiological changes in cardiac function and cause a higher incidence of heart failure in susceptible broilers.

Key Words: Broilers, Meat Meal, Heart Failure

487 Muscle proteins recovered from trout frames: Potential pellet binding agent and source of essential amino acids. C. K. Gehring*, J. Jaczynski, and J. S. Moritz, *West Virginia University*, *Morgantown*.

Pelleted diets improve live weight gain and feed efficiency over mash diets when fed throughout the grower period. Optimal broiler performance is contingent upon high pellet quality; however, due to manufacturing volume, transportation and handling, pellet quality in the broiler industry is often poor. While various pellet binding agents are available, one that is also a highly available source of essential amino acids has not been identified. The objective of this study was to recover muscle proteins from trout frames and investigate their use as a protein source and potential pellet binding agent. Proteins were recovered from trout frames via the isoelectric solubilization/precipitation method and the amino acid profile of the isolated protein slurry was analyzed. Concentrations of essential amino acids following solubilization at pH 12.0 were found to be (mg/g): isoleucine (42.11), leucine (69.5), lysine (76.34), methionine (26.21), phenylalinine (35.48), threonine (38.38), tryptophan (11.00), valine (49.93), and histidine (22.61). The essential amino acids were found to be at a high concentration (45%) of total amino acids. Solubilization at acidic pH resulted in greater percent yield on a dry matter basis: percent yield was 70.92 at pH 2.5 versus 55.83 at pH 12.0. Essential amino acid content was reduced by solubilization at pH 2.5 compared to pH 12.0 by 14.54%, 12.29% and 10.76% for methionine, lysine and threonine, respectively. Thus, solubilization at pH 12.0 was determined to be optimal. Alluding to its possibility as a pellet binding agent, trout muscle protein was found to form a stable thermally-induced gel. These results indicate that recovered muscle protein from trout frames may have potential as a high quality protein source and pellet binding agent. Future research will examine the effects of trout protein slurry on pellet quality and manufacturing variables using our pilot feed mill and true amino acid digestibility will be established by precision feeding cecectomized roosters.

Key Words: Pellet Quality, Pellet Binding Agent, Essential Amino Acids

488 Effects of diet preconditioning on the true metabolizable energy of guar meal. O. Gutierrez*, A. L. Cartwright, and C. A. Bailey, *Texas A&M University*, *College Station*.

Several studies report adaptive physiological responses in animals fed high-fiber diets resulting in increased capacity for nutrient utilization. This study was conducted to determine whether similar adaptation occurs with respect to true metabolizable energy (TME) of guar meal (GM) in adult Leghorn roosters. Guar meal contains approximately 11% crude fiber and 18% residual gum, which is comprised of a β-1→ 4-linked D-mannopyranose chain with α-1→6-linked D-galactopyranose branches. A total of 28 roosters were subjected to an initial assay in order to establish a baseline TME for GM. A cross-over designed feeding experiment followed, in which basal diets and high-fiber diets (25% GM) were administered for a period of three weeks before subsequent bioassays were conducted. Results of this experiment indicate that birds which consumed the high-fiber diet prior to assay had a ~9 % reduction in their ability to utilize energy from GM than birds fed the basal diet. Physiological responses were reversible, in that birds consuming the high-fiber diet initially reverted to increased levels of energy utilization when administered the basal diet. However, this increase in energy utilization was intermediate to baseline observations and most likely indicates that additional time is required for the complete recovery of the digestive ability of birds fed high-fiber diets.

Key Words: Diet Preconditioning, True Metabolizable Energy, Guar Meal

489 Energy, protein, and starch digestibility of pea as affected by grind size and cold pelleting in broiler chickens. S. M. Ebsim*, T. D. Warkentin, and H. L. Classen, *University of Saskatchewan*, *Saskatoon, SK, Canada*.

Pea is an accepted ingredient in poultry feeding but information on the impact of feed processing on its nutritional value is minimal. Therefore, a 2 x 2 factorial arrangement was used to study the impact of hammer mill screen size (3.125 mm – S; 6.25 mm – L) and feed form (mash – M; cold pelleting – P) on the rate and degree of pea nutrient utilization in broiler chickens. Pea-based (89.7% pea) were fed from 0 to 21 d of age and included acid insoluble ash as a digestibility marker. Feces were collected from d 19 to 21 for determination of apparent metabolizable energy (AME). Digesta samples were collected from the anterior and posterior of both the jejunum and ileum at 21 d of age to determine the rate of starch and protein digestibility. There were no significant interactions between treatments and therefore the results are presented as main effects. Finer grinding resulted in a higher diet AME ($P<0.01$) than course grinding (S – 2748 kcal/kg vs L – 2537 kcal/kg) but cold pelleting had no effect on this trait. Protein and starch digestion were not affected by grind size except in the posterior ileum where the starch (70.1 vs 59.7%) and apparent protein digestibility (82.4 vs 77.1%) were increased ($P<0.01$) by the S treatment. In contrast, cold pelleting increased the digestibility of protein in the posterior jejunum and anterior ileum ($P<0.01$) but not in the posterior ileum. Starch digestibility was increased by cold pelleting in all portions of the intestine ($P<0.05$) with digestibility values of 59.6% and 70.21% in the posterior ileum for mash and cold pelleting treatments, respectively. The data demonstrate that 15-22% of pea starch and 11-16% of pea protein was digested in the ileum. In conclusion, fine grinding and cold pelleting independently affected the AME, protein, and starch digestibility of pea for broiler chickens.

Key Words: Broiler, Starch, Protein

490 Nutritional value of corn versus sorghum when ground through different screen sizes and used in diets for broiler chicks. C. Feoli*[1], J. D. Hancock[1], M. C. Herrera[2], G. M. Herrera[2], M. J. Rios[2], F. Vargas[3], and S. C. Mason[4], [1]*Kansas State University*, *Manhattan*, [2]*Universidad Nacional Agraria*, *Managua, Nicaragua*, [3]*Asociacion Nacional de Productores de Sorgo*, *Managua, Nicaragua*, [4]*University of Nebraska*, *Lincoln*.

Seven hundred twenty 1-d-old broiler chicks (Cobb x Cobb with an average initial body weight of 43 g) were used in a 14-d growth assay to determine the nutritional value of corn (No. 2 yellow corn imported from the United States) vs sorghum grain (Pinolero-1, a locally adapted variety with white seeds). The corn and sorghum were ground through a hammermill with screens having 6.4 vs 4 mm diameter openings to yield a 2 x 2 factorial arrangement of treatments. The birds were allotted into 1.8-m x 3.4-m pens with 30 birds/pen and six pens/treatment. Feed (meal form) and water were consumed on an ad libitum basis with the diets formulated to 1.29% Lys, 0.99% Met+Cys, 1.1% Ca, and 0.49% available P. Chicks had greater ($P < 0.008$) average daily gain (ADG) when the cereal grains were ground through the smaller screen size and this effect was most pronounced for chicks fed diets with sorghum (cereal grain x screen size interaction, $P < 0.04$). There were no effects ($P > 0.20$) of grain source or screen size on average daily feed intake (ADFI) but gain to feed ratio (G:F) was markedly improved when sorghum grain was ground through the screen with smaller openings (grain source x screen size interaction, $P < 0.006$). For the diets with corn ground through 6.4 and 4 mm screens and the diets with sorghum ground through 6.4 and 4 mm screens, ADG was 31.1, 31.4, 29.2, and 31.6 g/d, ADFI was 47.4, 50.9, 49.1, and 47.7 g/d, and G:F was 0.66, 0.62, 0.59, and 0.66 g/g, respectively. In conclusion, when ground to an appropriately fine particle size, Nicaraguan sorghum grain was equal to imported corn in nutritional value for broiler chicks.

Key Words: Sorghum, Particle Size, Broilers

491 Live performance evaluation of broilers fed all vegetable corn-soy diets supplemented with an Alpha Amylase - Beta Glucanase blend. S. L. Vieira*, D. M. Freitas, J. L. Coneglian, J. E. M. Peña, and J. Berres, *Universidade Federal do Rio Grande do Sul*, *Porto Alegre, RS, Brazil*.

The use of enzyme blends directed to improve nutrient and energy utilization in broiler feeds is increasing. Generally, non starch polysaccharides are preferred target substrates for exogenous enzymes. Starch, however, is not completely digested by chickens. In this study, 1,750 Cobb X Cobb 500 broiler chicks were placed in 70 floor pens, 25 per pen. All birds were fed corn-soybean meal all vegetable diets in feeding programs composed by 7 treatments and 10 replications in a Randomized Block Design. Feeds were provided from 1 to 7, 8 to 21,

22 to 35 and 35 to 40 days. A Positive Control feeding program was formulated with ME levels as follow: 2,950; 3,050; 3,100 and 3,150 kcal ME/kg. Three Negative Controls had 60, 90, and 120 kcal ME/kg graded reductions related to the Positive Control. Supplementation of the lowest energy Negative Control with 200, 300 and 400 g/Ton of an alpha amylase â€“ beta glucanase blend (Ronozyme A - 200 kilo-Novo alpha-amylase units and 350 fungal beta-glucanase units per g) was used in the other three feeding programs. All diets had nutrients to meet or exceed NRC (1994). Body weight, feed intake and feed conversion were weekly evaluated. At the end of the study, broilers demonstrated gradual losses in their performance in parallel with the graded reductions in feed energy. However, including the enzyme at 300 and 400 g/Ton of feed partially alleviated these negative effects. Taking the overall feed conversion in consideration, benefits of enzyme inclusion were similar to those obtained with feeding programs having 30 and 60 kcal ME/kg higher than the Negative Control, respectively for 300 and 400 g/Ton. The observation of the weekly results indicated that enzyme efficacy was mainly demonstrated after 21 days of age. Mortality was not affected by the treatments.

Key Words: Broiler, Enzyme, All Vegetable Feed

Physiology & Endocrinology - Livestock and Poultry: Role of Lipids and Fatty Acids in Regulation of Reproductive Function

492 The role of omega-3 and -6 fatty acids in regulation of reproductive function in horses. E. L. Squires*, *Colorado State University*, *Fort Collins*.

Semen contains high levels of polyunsaturated fatty acids (PUFA), in particular the long-chain fatty acids docosapentaenoic acid (DPA) and docohexaenoic acid (DHA). Ability of sperm to resist cold shock is related to lipid composition of the sperm membrane. Approximately 30% of stallions have sperm that do not withstand the rigors of cooling and/or freezing. Three studies have focused on the effect of DHA supplementation to stallions. Brinsko et al. (2005) used 8 stallions in a 2×2 cross-over design. Stallions served either as control or were fed a DHA-enriched product for 14 weeks. They reported a 3-fold increase in the semen levels of DHA. Although DHA supplementation had no effect on fresh semen, it did increase total, progressive and rapid motility after 48 hr of cooling and after freezing and thawing. The most dramatic response to DHA was seen in those stallions that prior to treatment had <40% motility after 24 hr of cooling. Harris et al. (2006) conducted a similar study in which 6 stallions were fed either a basal diet with no supplementation or a basal diet supplemented with 29 g of PUFA. Supplementation resulted in a 46% increase in daily sperm output at the end of the 90-day trial. Supplemented stallions also had a higher percentage of morphologically normal spermatozoa. In the third trial, conducted at Colorado State University, 10 stallions were collected daily for 8 days and the data used to establish baseline values for seminal characteristics. Stallions were assigned to either a control diet or control diet containing 270 g DHA product. There was a significant increase in the daily number of motile sperm in the ejaculate of fresh semen, as well as semen stored for 24 hr at 5°C. These combined studies demonstrated that supplementation of stallions with PUFA containing DHA resulted in improvement in sperm numbers and semen quality.

Key Words: Stallion, Omega-3 Fatty Acid, Semen

493 Addition of protected fat in ewes with different corporal condition on superovulation and conception rate. P. Molina[1], T. Sánchez[1], O. Mejía[2], J. Nuñez[2], E. García*[3], O. D. Montañez-Valdez[4], J. Cordero[1], J. Peralta[1], M. E. Ortega[1], R. Nieto[5], E. Mendoza[1], and R. Avila[1], [1]*Colegio de Postgraduados*, *Montecillo, Estado de México, México*, [2]*Facultad de Medicina Veterinaria y Zootecnia, UNAM*, *Tres Marías, Municipio de Huitzilac, México*, [3]*Centro Universitario de la Costa Sur de la Universidad de Guadalajara*, *Autlán, Jalisco, México*, [4]*Centro Universitario del Sur de la Universidad de Guadalajara*, *Ciudad Guzmán, Jalisco, México*, [5]*Instituto Tecnológico Agropecuario No.6*, *Huejutla, Hidalgo, México*.

Thirty days before synchronization there were two groups of Dorset ewes in very good body condition: In T1 ewes were fed with commercial supplement and oat straw, and in T2 ewes were fed with oats straw to lower the body condition of this group and both groups received this diet for a month. Then six ewes of each group were superovulated (donors) and the rest remained as receptor ewes (T1 n=20; T2 n=16). At the beginning of the superovulation treatment dorsal fat of the ewes was measured with ultrasound and body weight was recorded. During the first 8 days of synchronization and superovulation treatment both groups received 100 g of protected fat and same diet as T1, synchronization for donors and receptors was performed by sponges of fluorogestone acetate (FGA, 40 mg) during 12 days. Receptor ewes received 200 U.I of eCG 12 h before sponges removal. Donor ewes were superovulated with decreasing doses of FSHp two days before and after sponges removal and embryos were obtained and transferred seven days later. Average weight of ewes at the beginning of estrus synchronization was 68.9 and 64.6 kg, for T1 and T2, respectively (P=0.07), while average dorsal fat was 2.5 and 1.97 mm for T1 y T2, respectively (P<0.05). At synchronized estrus ewes of T1 and T2 weighted 71.69 and 69.03 kg (P>0.05) and dorsal fat measures were 3.5 and 3.29 mm (P>0.05). All ewes from T1 (100%) showed response to superovulation, while in T2 only 66.7%. Ewes from T1 showed an average of 9.5 ± 0.85 corpus luteum, compared to T2 with 14.75 ± 2.36 (P<0.05). Number of embryos recovered for T1 was 7.17 ± 1.10 and 11.5 ± 2.36 for T2 (P=0.09). Average number of good quality embryos was 6.7 ± 0.84 for T1 and 8 ± 2.86 for T2 (P>0.05). Percentages of conception rate were 35% and 31.5%, for T1 and T2, respectively (P>0.05). Under the conditions of the present experiment was observed that ewes with lower dorsal fat, with the addition of protected fat for a short period increased ovulation rate but not gestation rate.

Key Words: FSH, Embryos, Dorset

494 Dietary omega-3 and omega-6 fatty acids and reproduction in dairy cattle. L. Badinga* and C. Caldari-Torres, *University of Florida*, *Gainesville*.

Fat supplementation has become a common practice in the dairy industry due to the inability of high-producing dairy cows to maintain a positive energy balance during the transition to lactation. Available

evidence indicates that dietary supplementation of long-chain fatty acids stimulates ovarian follicular development, increases serum progesterone concentration, attenuates eicosanoid synthesis, and improves fertility rates in cattle. In several animal models, supplemental n-3 polyunsaturates inhibit prostanoid synthesis, whereas n-6 polyunsaturated fatty acids tend to increase peripheral prostaglandin $F_{2\alpha}$ concentration. A recent study indicated that the net inhibitory effect of n-3 fatty acids on eicosanoid synthesis may vary, depending on the ratio of n-6 and n-3 fatty acids in the uterus. Evidence also is rapidly accumulating that supplemental polyunsaturated fatty acids not only regulate prostaglandin biosynthesis, but may also affect the production of inflammatory biomarkers in livestock. This may lead to earlier recovery of immune functions in lactating dairy cows fed a fat-supplemented diet. The objective of this review is to summarize the effects of dietary n-3 and n-6 polyunsaturates on reproductive efficiency and to discuss the putative mechanisms by which these fatty acids may affect reproductive responses in dairy cattle.

Key Words: Omega Fatty Acid, Reproduction, Dairy Cow

495 Reproductive function in dairy cows fed a lipid encapsulated conjugated linoleic acid supplement. G. E. Mann*[1], A. L. Lock[2], D. E. Bauman[3], and N. R. Kendall[1], [1]*University of Nottingham*, *Sutton Bonington, Loughborough, UK*, [2]*University of Vermont*, *Burlington*, [3]*Cornell University*, *Ithaca, NY*.

In attempting to address the problem of poor energy status during the early post partum period the intrinsic drive of the modern Holstein to partition energy intake toward increased milk output has exasperated attempts to reduce negative energy balance through improvements in diet. However, recent studies have shown that feeding of lipid encapsulated conjugated linoleic acid (LE-CLA) during the early post partum period can reduce milk fat and thus milk energy. In this study we have investigated reproductive function in multi parous Holstein-Friesian dairy cows fed LE-CLA. The study was carried out between September and March in cows individually fed a typical TMR ration based on maize and grass silage including rolled wheat, sugar beet pulp nuts, molasses and minerals. From day 21 following calving until day 100, cows received 84g of either LE-CLA containing a 50:50 mixture of cis-9, trans-11 and trans-10, cis-12 CLA supplying 7.5g of each isomer (n=13) or an equivalent amount of rumen-inert fat (Megalac; n=13) top dressed onto the standard ad lib TMR. Throughout the study daily milk samples were collected for progesterone analysis in order to accurately monitor reproductive function. During the study cows were inseminated at natural oestrus, observed by skilled stockmen according to the normal herd management routine. The proportion of LE-CLA cows showing normal cycles (12/13) was greater ($P<0.05$) than that seen in the control cows (6/13). During the trial period a greater ($P<0.05$) proportion of LE-CLA cows were inseminated (11/13) than control cows (5/13) and by the end of the trial period 7/13 LE-CLA cows had conceived compared with 4/13 control cows. The mean day of first insemination was 66±4 for the CLA treated cows and 75±9 for the control cows. These results show improved reproductive function in post partum dairy cows during the feeding of LE-CLA. The LE-CLA used in this trial was supplied by BASF.

Key Words: Cow, CLA, Reproduction

496 Dietary lipids and reproduction in beef cattle. R. N. Funston*, *University of Nebraska*, *West Central Research and Extension Center, North Platte*.

Inadequate dietary energy intake and poor body condition can negatively affect reproductive function. Supplemental lipids have been used to increase energy density of the diet and may also have direct positive effects on reproduction in beef females. Several fatty acid sources have been studied as they relate to reproductive function. Plant derived oils appear to have the greatest impact on reproduction, common sources include: sunflower, safflower, cottonseed, rice hulls, and soybeans. Animal tallow and calcium salts of fatty acids escape rumen biohydrogenation to a greater extent and are incorporated into adipose tissue and milk. Effects on reproductive function appear to be more variable. Polyunsaturated fatty acids such as those in fishmeal also bypass the rumen but have been documented to affect reproductive processes. Lipids have been fed before and after calving, during the breeding season, and during heifer development. Response to lipid has been investigated through measuring: body weight and body condition score, age at puberty, postpartum interval, first service conception rates, pregnancy rates, calving interval, mammary gland development, milk yield, milk composition, calving difficulty, and calf birth and weaning weight. Animal response appears to be dependent on body condition score, age (parity), nutrients available in the diet (pasture or range conditions), and type of lipid supplemented. To elucidate potential mechanisms of action scientists have investigated: changes in follicular and uterine development, hormonal profiles, brain function, and embryonic development. Feeding supplemental lipid has resulted in varied and inconsistent results on reproductive function. Elucidating mechanisms of action on how supplemental lipid can influence reproductive function has been a difficult process. The complexity of the reproductive system and makeup of lipid supplements are often confounded by management conditions and forage quality both in research and commercial feeding situations. This has contributed to inconsistencies in research findings.

Key Words: Lipid Supplementation, Beef Cattle, Reproduction

497 The role of dietary omega-3 and omega-6 fatty acids in swine reproduction. S. K. Webel*, J. D. Spencer, and A. M. Gaines, *JBS United, Inc.*, *Sheridan, IN*.

The positive impact on reproduction of altering the omega-3:6 ratio by including supplemental omega-3 fatty acids (FA's) from marine sources has been reported for both the boar and sow. The lipid components of the spermatozoa plasma membrane contains a high level of polyunsaturated FA's. Inclusion of dietary omega-3 FA's to increase the ratio of decohexaenoic acid (DHA) in the plasma membrane has been associated with improved sperm cell viability as measured by motility, cytology, storability and increased number of AI doses obtained per ejaculate collection (Maldjian et.al. 2003, AOCS Press). Increasing the ratio of marine source omega-3 FA's in sow diets from day 60 of gestation to farrowing improved piglet prenatal survival (Rooke, 2003 Minn. Nut. Conf). Further positive effects of altering the omega-3:6 ratio were discussed and reviewed by Levis and Reese (AASV, 2003). Research in our laboratory has demonstrated the benefits of increasing dietary levels of marine sourced omega-3 FA's

on litter size in gilts (Spencer, et.al. JAS 82, Suppl. 2, p81) and sows (Webel, et.al. 2003, JAS 81, Suppl 1, p18). Improved embryo and fetal survival is the hypothesis for the observed increase in litter size. Additional recent research has demonstrated alteration in tissue concentrations and ratios of specific omega3 FA's in the fetus and newborn piglets, when gestation diets of dams were supplemented with dietary sources of marine omega-3 FA's. This enrichment of tissue omega-3 has been associated with increased preweaning survival, weaning weight, immune function and grow-finish performance. The authors will review and discuss relevant literature as well as additional unpublished research.

Key Words: Omega-3, Reproduction, Swine

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498 Influence of hatching egg weight and Japanese quail breeder flock age on embryonic mortality stages, hatchability and chick quality measurments. T. M. El-Sheikh*, *Sohag University*, *Sohag, Egypt*.

This study was carried out to determine the effects of the breeder age and the egg weight of the Japanese quail on the hatchability, the embryonic mortality, and one-day old chick quality. twenty-four hundred eggs were obtained from the hens at the age of 8 weeks, at the age of 16 weeks and at the age of 24 weeks. The eggs were grouped according to their weight as follows; 8.5-10.5, 10.51-11.5 and 11.51-13.5 g. The traits measured were embryonic mortality, fertility, hatchability and hatching chick quality. Pre-incubation, early, mid and late embryonic mortality were 3.18, 5.81, 7.35 and 9.76%; 3.35, 5.56, 7.62 and 10.41 and 1.85,3.02, 3.99 and 5.21% respectively, for 8, 16 and 24 weeks parents age.The percent of pre-incubation, early, mid and late embryonic mortality were 1.96, 4.55, 5.85 and 7.61%, respectively for the smaller eggs, 3.12, 4.79, 6.86 and 8.98 for mid egg weight and 3.31,5.04, 6.25 and 8.79% for the largest egg weight. Malformation and malposition of the embryonic dead and piped eggs were affected by breeder age and egg weight. Fertility was decreased as the parents age increase while the opposite trend was found with hatchability. Fertility, hatchability of set eggs and hatchability of fertile eggs were 81.44, 58.81 and 73.43%, respectively, for the youngest flock, 78.51, 61.48, 78.31% for mid flock age and were 73.73,62.68, and 85.12% for the oldest flock age. The breeder age and egg weight had significant effect on fertility, hatchability hatched and chick quality ($P<0.05$). Abnormal chicks, dead in shell and naval wet were increased with older parents and small egg weights. It was observed that the chick weight increased in parallel with increasing egg weight. The average chick weight was 10.94, 11.06, and 12.32 for parent flock of 8, 16, and 24 weeks of age , respectively. The average chick weight was 9.88, 11.01, and 12.23 grams for smaller, mid and bigger egg weight, respectively. The incubation period was shorter with increasing egg weight and breeder age.

Key Words: Quail Breeder Age, Chick Quality, Hatchability

499 WITHDRAWN BY AUTHOR.

500 Effects of supplemental dietary phytase and 25-hydroxycholecalciferol on the digestive and reproductive organ characteristics of commercial layers inoculated Before or at the Onset of Lay with the F-Strain of *Mycoplasma gallisepticum*. E. D. Peebles*[1], S. L. Branton[2], M. R. Burnham[1], S. K. Whitmarsh[1], and P. D. Gerard[1], [1]*Mississippi State University*, *Mississippi State*, [2]*Poultry Research Unit, Agricultural Research Service, United States Department of Agriculture*, *Mississippi State, MS*.

In 3 trials, the effects of dietary supplementation with phytase (PHY) and 25-hydroxycholecalciferol (25-D3) on the digestive and reproductive organ characteristics of commercial layers that were inoculated pre-lay (12 wk of age) or at the onset of lay (22 wk of age) with the F-Strain of *Mycoplasma gallisepticum* (FMG), were assessed at 58 wk of age. Experimental layer diets which included either a basal control diet or a control diet supplemented with 0.025 % PHY (600 FTU / kg of diet) and 25-D3 (34.5 µg pure crystalline / kg of diet) were fed from 20 through 58 wk of age. As a percentage of total oviduct weight, magnum weight was lower in birds that were inoculated (sham or FMG) at lay onset compared to those that were inoculated pre-lay, and in FMG-inoculated birds, relative duodenum length was greater in those inoculated at 12 compared to 22 wk. Also, as percentages of organ weight or length, infundibulum length and isthmus weight were increased, whereas duodenum length was decreased by dietary supplementation with PHY and 25-D3. The overall timing (12 versus 22 wk) of inoculation can affect the reproductive organ characteristics of layers; whereas, more specifically, the timing of an FMG inoculation may affect their digestive organ structure. Furthermore, independent of inoculation timing and type, both the reproductive organ and digestive systems of laying hens may be influenced by dietary supplementation with PHY and 25-D3.

Key Words: *Mycoplasma Gallisepticum*, Phytase, 25-Hydroxycholecalciferol

501 Validity of fertilization assessment of broiler hatching eggs. R. W. Keirs*, P. D. Gerard, and E. D. Peebles, *Mississippi State University*, *Mississippi State*.

Validation of broiler breeder flock hatching egg fertilization is important for monitoring the efficacy of breeder programs, a hatchery's efficiency including each incubational unit, the variability of a flock's hatch in different machines, inventory accountability, and in developing pragmatic hatching parameter baselines. This study included eggs from 6 flocks set in multi-stage incubators, and filling all 90 trays (15,120 eggs) of a single hatcher. Total egg residue (non-fertilized and all embryos) left on trays after hatch pull were accounted for by the Hatching Efficiency Analysis System (HEAS). Validation of fertilization levels were obtained utilizing only 4 trays of hatch residue which were pre-selected under the HEAS program. These residue

results, each which were from 1 breeder flock, were compared to the same results from the entire 90 hatcher trays (15,120 eggs) for the same flock and hatcher. The locations of all 4 of the pre-selected trays of hatch residue were within the first vertical row as one faces the hatcher. Starting at the top of the row and progressing downwards, tray levels 1, 5, 10, and 15 were selected. Also, through similar comparisons, the validity of using 2 or 8 trays rather than 4 was considered. A computer statistical model was generated in which the SD of non-fertilized eggs remaining on 2, 4, or 8 trays, which represented sub-samples of all 90 trays of a given flock, were used. The validity of fertilization level was found to be proportional to the computed SD, and increased as SD decreased with increasing fertilization and number of trays sampled. To test the validity of fertilization determination using only 4 trays, the 6 breeder flocks (28-59 wk of age) were arranged by increasing fertilization using the 90 tray results (85.7, 93.2, 95.2, 95.5, 96.6, and 97.5%). The validity of fertilization determination using 4 trays, when expressed as a percentage of their respective 90 tray results, were 99.8, 98.8, 98.0, 99.0, 98.9, and 99.4%. The collective validity of the 6 flocks and all 4 tray groups was 99.7%.

Key Words: Broiler Hatching Eggs, Fertilization, Incubation

502 Effectiveness of immersion of hatching eggs into disinfectant solutions in a commercial hatchery. J. M. Mauldin*[1], A. L. O'Shaughnessy[2], and M. T. Musgrove[3], [1]*The University of Georgia*, *Athens*, [2]*United Promotions, Inc*, *Atlanta, GA*, [3]*ARS-USDA*, *Athens, GA*.

This study was conducted at a broiler hatchery and compared effects of immersing hatching eggs into disinfectant solutions. Treatments consisted of untreated control, Virkon (1000 ppm), and Timsen (400 and 800 ppm). Treatments were evaluated by comparing microbial recovery, incubation moisture loss, chick wt, and breakout analysis. Each of 30 egg trays within a farm buggy was randomly assigned to a treatment group. Eggs from treatment groups were immersed into a 114 L vat of 37°C disinfectant solution for 150 s. The untreated control group was not dipped. Each tray was weighed and marked by group and placed into setter buggy. Ten eggs from each group were sealed in bags and transported to the lab. Ten egg shells per treatment were crushed in diluent and individually analyzed for presence and level of aerobic microorganisms, Enterobacteriaceae, and fungi using standard cultural methods. The test egg buggy was then incubated. On d 17 eggs were transferred to hatcher, each tray was reweighed to determine % moisture weight loss. On d 21 the hatch was pulled and 100 chicks per tray were weighed. All unhatched eggs were subjected to breakout analysis. Results are listed for the four treatments: untreated controls, Virkon 1000 ppm, Timsen 400 ppm, and Timsen 800 ppm. Prevalence of aerobic microorganisms in treated eggs was 100%, 90%, 50%, and 40%, respectively. Enterobacteriaceae prevalence results were 30%, 10%, 10%, and 0% while fungi prevalence results were 70%, 40%, 30%, and 40%. Aerobic bacteria levels were 4.3, 2.9, 0.7, and 0.4 log cfu/mL egg sample. Enterobacteriaceae levels were 0.4, 0.4, 0.3, and 0 log cfu/mL egg sample. Fungi levels were 0.7, 0.3, 0.2, and 0.3 log cfu/ml. These results demonstrate that immersion of eggs into Timsen solutions at 400 and 800 ppm was superior for egg sanitation. No significant differences among treatments were noted for daily % moisture loss or in chick wt as % of initial egg wt. Small differences were noted in some hatchability and breakout analysis measurements.

Key Words: Hatching Eggs, Sanitation, Hatchability

503 Effects of multistage or single-stage incubation on broiler chick quality and performance. B. D. Fairchild*[1], J. M. Mauldin[1], and R. J. Buhr[2], [1]*University of Georgia Poultry Science Department*, *Athens*, [2]*USDA, ARS*, *Athens, GA*.

Single-stage (SS) incubation has benefit over multistage (MS) incubation by matching incubator environment to embryo needs. Eggs from a young breeder flock may be incubated differently than eggs from old flocks. Information on chick quality and performance are scarce. The objective of this study was to compare quality and performance of chicks of three breeder flock ages when incubated in MS or SS. Heritage chicks from young, prime and old flocks were incubated at a broiler hatchery in either Jamesway MS or SS incubators. Chicks (450) from each treatment were placed in floor pens and provided standard diets and water ad libitum. Each pen contained 55 chicks with 0.7 ft2 per bird. Feed and BW were obtained at 0, 7, and 21 d and mortality monitored daily. On hatch day, BW with and without yolk, liver, heart and intestine wt and length were obtained from 10 chicks from each treatment. Data were arranged in a 2x3 factorial and analyzed by the GLM procedure of SAS. Chicks from SS were larger than MS chicks. Relative organ wt was not different. Residual yolk and intestinal wt per mm of intestine were greater in SS than MS. Chick BW from old breeders were larger than chicks from prime breeders which were larger than those from young breeders. An age difference in residual yolk was noted and followed the same trend as chick BW. There was an interaction between breeder age and incubation treatment for intestinal length and relative liver wt. MS incubation did not influence breeder age effects on either variable. However, SS incubation increased intestinal length in chicks from prime flocks compared to other ages. Relative liver wt were greater in SS chicks from young breeder flocks than the other ages. No differences in SS and MS treatments were noted after hatch. By 7 d, significant effects were due to breeder age in feed consumed, BW and feed conversion. At 21 d, no differences in BW were noted, but chicks from young breeder flocks had better feed conversion. SS incubation appears to improve some characteristics associated with chick quality and may improve 7 d performance. However, these differences were not observed at 21 d.

Key Words: Broiler Performance, Incubation, Breeder Age

504 Comparisons of hatchability measures in Jamesway Platinum single stage incubators with Jamesway Multistage incubators in broiler hatchery in Georgia. J. M. Mauldin*, S. A. Kuzniak, and T. L. Gardino, *The University of Georgia*, *Athens*.

A research project was conducted at a broiler hatchery to compare 3 120,000 egg capacity Jamesway Platinum single stage (SS) incubators with multistage (MS) Jamesway incubators. Comparisons included hatchability, hatchability of fertile eggs, embryo mortality, contamination and other hatchability parameters. The study was divided into 3 periods because of an airflow problem during the first 7 mo of the study (May, 2005- Dec., 2005 -- period 1). During period 2 (Jan., 2005 – Dec., 2005) data were collected in SS incubators only while engineers corrected the airflow problem. These results are not given since there were no comparisons of incubator types. In Periods 1 and 3 (May, 2006 – Jan., 2007), eggs from the same flocks were divided into SS and MS. For all 3 periods, a breakout analysis was conducted on each Monday hatch day by selecting 2 trays per incubator buggy, SS and MS and examining all unhatched eggs. For period 1,

percentages for fertility, hatchability, hatch of fertiles (HOF) were 94.09, 82.26, and 87.43, respectively in MS. SS percentages for the same parameters were 93.54, 80.36, and 89.51. The differences between hatchability and HOF were significant (p<.05). Early and late embryo mortality percentages for MS were 4.52 and 2.31; SS, 4.05 and 2.97. Differences were significant (p<.05). SS had significantly higher percentages (p<.05) for pips and cull chicks than MS (1.15 vs. 0.57 and 0.84 vs. 0.43). SS had significantly fewer (p<.05) contaminated eggs than MS (0.17% vs. 0.25%). Changes in the airflow during period 2 resulted in a dramatic improvement in many hatchability percentages in period 3 for SS. For example, hatchability and HOF were significantly higher (p<.05) at 84.08% and 89.74% in SS than MS 83.05% and 89.12%. Also, significant improvements (p<.05) were noted in comparisons of embryo mortality in SS (early dead=3.59% and late dead=2.21%) vs. MS (4.34% and 2.86%). As in the first period, the period 3 incidence of contaminated eggs was significantly lower in SS incubated eggs than in MS (0.22%, SS; 0.28%, MS).

Key Words: Single Stage, Hatchability, Embryo Mortality

505 A comparison of effects of single stage vs. multistage incubation on hatching egg moisture weight loss and chick weights in a broiler hatchery in Georgia. J. M. Mauldin*, S. A. Kuzniak, and T. L. Gardino, *The University of Georgia*, *Athens*.

A Research project was conducted at a broiler hatchery in Georgia comparing 3 120,000 egg capacity Jamesway Platinum single stage (SS) incubators with existing multistage (MS) Jamesway machines. Comparisons were made between the two incubator types for incubation egg moisture wt loss, egg wt at transfer, and chick wt as a percentage of initial egg wt. The study was divided into 3 periods because an airflow problem was recognized during the first 7 mo of the study (May, 2005- Dec., 2005, period 1). During period 2 (Jan., 2005 – Dec., 2005) data were collected in SS incubators only while engineers adjusted airflow distribution. Consequently, there are no comparative data to present in this period. In period 3 (May, 2006 – Jan., 2007) data were collected for both types of incubators. In Periods 1 and 3, eggs from the same flocks were divided into SS and MS incubators. In the hatchery, 1 tray of eggs per setter buggy (168 eggs/tray) was weighed as initial egg wt. At transfer, the same trays were weighed for transfer wt and percent moisture loss. 100 chicks in each of 2 trays/buggy were weighed for chick wt as % of initial egg wt. In Period 1, the initial egg wt averaged 60.03 g in MS and 59.37 g in SS. Transfer wt during period 1 averaged 52.22 g/egg in MS and 53.66 g/egg in SS. Differences were significant (p <.05). Moisture wt loss means at transfer were significantly different (p <.05); 12.83% for MS and 9.60 %, SS. At hatch, MS incubated chicks averaged 66.84 g and SS, 68.27 g. Differences were significant (p <.05). Period 3 resulted in initial average wt/egg of 61.44 g for MS and 60.38 g, SS. Transfer wt means were 53.76 g, MS and 55.00 g, SS. Differences were significant (p <.05). Moisture wt loss was significantly different (p<.05) between MS, 12.51% and SS, 8.91%. Chick wts averaged 40.77 g, MS and 41.49 g, SS. Chick wts as % of initial egg wt were 66.36%, MS and 68.71% for SS. Differences were significant (p <.05).

Key Words: Single Stage, Incubation, Moisture Wt Loss

506 Effect of single-stage incubation temperature profile and delayed placement on broiler performance to 40 days of age. J. T. Brake*, E. O. Oviedo-Rondon, P. W. Plumstead, K. E. Brannan, N. Leksrisompong, and J. H. Small, *North Carolina State University, Department of Poultry Science*, *Raleigh*.

Eggs produced by a 57-wk-old Ross 344 x Ross 708SF broiler breeder flock were subjected to four temperature profiles during incubation. Air temperature was either 36.9°C (Early Cool (EC)) or 38.0°C (Early Hot (EH)) during E 0-E 3 and then 37.5°C to E 17. From E 17 to hatching at E 21 air temperature was either 36.9°C (Late Cool (LC)) or 38.0°C (Late Hot (LH). Thus, four combinations (ECLC, ECLH, EHLC, and EHLH) were created. The chicks were sexed and half were placed within 2 h of removal from the hatcher at 504 h of incubation while half were held in the hatchery at 24-27°C for an additional 24 h before placement in the same facility. The chicks were then grown to 41 d of age to evaluate both live performance and carcass characteristics. The BW at placement followed the order of ECLC>EHLC>ECLH>EHLH for both sexes with an average BW of 45.1 g. The order completely reversed by 7 d in males but was no longer evident at 40 d. However, only the ECLC females were smaller than the other incubation groups at 7 d and there were no differences at 40 d. Delayed placement decreased 7d BW by 25 g in males and 19 g in females but only the males still exhibited a reduced BW at 40 d of age (2777 versus 2844 g) in conjunction with a reduced percentage dressed carcass. Surprisingly, the delayed placement chicks exhibited numerically reduced mortality at both 7 and 40 d of age.

Key Words: Incubation, Broilers, Chick Quality

507 The effect of flock age and egg storage period on organ development and broiler performance. A. Afsar[1], O. Elibol[1], and J. T. Brake*[2], [1]*Faculty of Agriculture, Department of Animal Science,Ankara University*, *Ankara, Turkey*, [2]*North Carolina State University, Department of Poultry Science*, *Raleigh*.

This study investigated the effects of broiler breeder flock age and length of egg storage on d-old broiler chick organ weights and subsequent broiler performance. Hatching eggs were obtained from Ross 344 male × Ross 308 female broiler breeders at 34 and 59 wk of age. Eggs were stored for 1, 5, or 10 d at 18 C and 75% RH prior to setting in Petersime incubators in a commercial hatchery under standard conditions. Chicks were necropsied at hatching at 504 h of incubation to detemine BW and weights of the heart, liver, gizzard, and yolk sac. There were 480 d-old male chicks assigned to 24 pens in a 3 × 2 factorial design with 4 replicates of 20 birds each. All chicks were reared in a floor pen experimental house under the same feeding, management, and immunization program with 20 chicks per square meter. Broiler BW, feed consumption, and livability were subsequently determined at 21 and 42 d of age. The percentage yolk sac was increased but percentage liver and gizzard were decreased by increased length of storage or greater flock age. Broiler BW was decreased at 21 and 42 d of age by increased length of storage (P<0.01) but was negatively affected by greater flock age only at hatching and 21 d. These data demonstrate that extended periods of egg storage change the relative development of broiler chick organs and permanently reduce broiler growth.

Key Words: Broilers, Incubation, Egg Storage

508 Optimizing brooding temperatures for large high yield broilers. E. O. Oviedo-Rondón*, M. J. Wineland, S. Funderburk, H. Cutchin, and J. H. Small, *Department of Poultry Science, North Carolina State University*, *Raleigh*.

Brooding is one of the most critical phases of broiler life due to their inability to thermoregulate. During the first days of life, birds mature from poikilothermic to homeothermic entities, and their body temperature is directly affected by ambient temperature. Two experiments were conducted in a commercial farm to estimate the best brooding temperature profiles for Ross-708 broilers raised to 9 weeks. The company standard house target temperature recommendations (CON) were compared with brooding profiles chosen to optimize the flock average rectal temperature (OB). Two paired houses with a comparable composition of day old broilers were used. In the first experiment, 19,800 chickens were placed in each house and processed at 66 days of age, during Winter/Spring conditions. In the second experiment 21,000 chickens per house were placed and processed at 63 days during Fall/Winter conditions. Rectal temperatures of at least 25 chickens per house were taken daily for the first two weeks and once a week until 35 days of age. House target temperatures were slowly reduced to avoid flock average rectal temperatures increasing above 105°F during the first 5 days. After first week, house target temperatures were adjusted to avoid average rectal temperatures rising above 107.5°F. Total BW, FCR, mortality, propane gas consumption, and flock uniformity were evaluated. Final average flock BWs were 77 and 50 grams better in the OB compared to CON in the first and second experiment, respectively. The OB group had better FCR in the first trial (1.88 vs 1.92) and no difference in the second trial (1.96). Flock uniformities improved with OB and gas consumption was reduced in 39%. The remarkable improvements in live performance and propane gas usage obtained with the OB treatment indicated that brooding temperatures could be optimized to maximize broiler performance and profitability.

Key Words: Broiler, Brooding Temperatures, Thermoregulation

509 Influence of photoperiods and light intensities meeting American and European guidelines on broiler performance. R. J. Lien*, J. B. Hess, and L. M. Stevenson, *Auburn University*, *Auburn, AL*.

Broilers were subjected to photoperiods and intensities which independently meet US National Chicken Council (NCC) or European Union (EU) guidelines to determine effects on performance. Seventy broilers were placed in each of 12 light controlled rooms. Six rooms were subjected to NCC photoperiods (long) (wk 1, 23L:1D: wk 2-6 20L:4D; wk 7, 23L:1D) and six to EU photoperiods (short) (d 1-3, 23L:1D; d 4-46, 14L:4D:2L:4D; d 47-49, 23L:1D). Six rooms were subjected to a common US intensities (dim) (wk 1, 0.25 FC; wk 2-6, 0.025 FC; wk 7, 0.25 FC) and six to EU intensity (bright) (wk 1-7, 2 FC). BW and feed consumption were determined at 9, 23, 37 and 49 d. Ten birds/sex/room were processed at 49 d to determine parts weights and yields. Data were analyzed as a 2X2 factorial arrangement. Short-dim decreased 9 d BW; otherwise, BW were unaffected by treatment. Feed consumption was reduced by dim intensity at 9 and 23 d, and short photoperiod at 23 d. Feed conversion was reduced by dim intensity at 9 and 23 d, and in the long-dim treatment at 49 d. Uniformity was increased by short photoperiod at 23 d, and in long-dim and short-bright treatments at 49 d. Nine d mortality was increased by short-dim treatment. At 49 d, mortality was increased by short-dim, reduced by long-dim and short-bright, and intermediate in the long-bright treatment. Carcass yield was increased by bright intensity and long photoperiod. Wing weight was increased by dim intensity. Total breast and fillet weights were increased by long-bright, decreased by long-dim and short-dim, and intermediate in short-bright treatments. Front half and total breast yield were increased by long-bright treatment. Wing yield was increased by long-dim, reduced by long-bright and short-bright, and intermediate in the short-dim treatment. Fillet yields were increased by long-bright, slightly reduced by short-bright, and markedly reduced by long-dim and short-dim treatments. Results indicate differences in photoperiod and intensity specified by EU and NCC guidelines will influence both broiler live and processing performance.

Key Words: Broiler Chicken, Photoperiod, Light Intensity

Ruminant Nutrition: Acid:Base Balance/Metabolism - Dairy

510 Calcium homeostasis, acid-base balance, and health status in periparturient Holstein cows fed diets with low cation-anion difference. W. X. Wu[1,2], J. X. Liu*[1], G. Z. Xu[1], and J. A. Ye[1], [1]*Institute of Dairy Sciences, Ministry of Education Key Laboratory of Molecular Animal Nutrition, Zhejiang University*, *Hangzhou, China*, [2]*College of Animal Science, Guizhou University*, *Guiyang, China*.

Forty multiparous Holstein dry cows on d 21 prepartum were randomly allocated to four blocks of 10 cows to examine the effects of reducing the dietary cation-anion difference (DCAD) on calcium homeostasis, acid-base balance, health status, and subsequent lactation performance. The reduced DCADs (Na + K - Cl - S, mEq/kg DM) of +150, +50, -50, and -150 were obtained by addition of anionic salts. Reducing DCAD resulted in mild metabolic acidosis indicated by the sharp decline of urinary pH, and minor reductions of blood pH and HCO_3^- concentration. Greater plasma calcium availability was sustained at the highest level in cows fed -150 DCAD diet close to the time of calving, and the reduced DCAD had a close association with the means of plasma calcium from d 3 prepartum to d 3 postpartum. On d 1 and 2 postpartum, the highest colostrum composite calcium concentration was observed in cows receiving -150 DCAD diet. No case of milk fever occurred within any diets, but feeding negative DCAD diets improved cow health status over the two positive DCAD diets. The milk yield and fat, protein, and lactose compositions; and 4% fat-corrected milk production were not significantly affected by DCAD treatments. It is suggested that urinary pH is an effective indicator of extracellular fluid acid-base balance, and that feeding negative DCAD in late gestation period is beneficial for dairy cows in blood calcium homeostasis and improvement of health status.

Key Words: Dietary Cation-Anion Difference, Calcium Homeostasis, Periparturient Holstein Cows

511 Dietary Na:K ratio effect on milk performance and mineral metabolisms in mid-lactation cows during summer. W. Hu* and L. Kung, Jr., *University of Delaware*, *Newark*.

The objective was to determine the effect of dietary Na:K ratio on milk performance and mineral metabolisms in lactating cows during summer. Fifteen mid-lactation Holstein cows averaging 160 days in milk were used in a replicated 3 × 3 Latin square design with treatments of dietary Na:K molar ratios (0.21, 0.53, and 1.06). The diets contained 0.25% Na and 2.00% K, 0.50% Na and 1.60% K, and 0.75% Na and 1.20% K [on a dry matter (DM) basis] respectively, with same dietary cation-anion difference (DCAD) of 33 meq (Na + K - Cl - S)/100 g of DM. Quadratic effect of the Na:K ratio occurred ($P = 0.03$) on DM intake (28.4, 27.5, and 28.3 kg/d). The Na:K ratio did not affect ($P > 0.10$) milk yield (39.2, 39.0, and 39.4 kg/d), milk composition (3.68, 3.53, and 3.59% fat; 3.00, 3.00, and 3.02% protein; and 8.60, 8.62, and 8.63% SNF), coccygeal venous plasma concentrations of HCO_3^- (30.0, 28.2, and 29.6 meq/l), Na^+ (137.2, 136.1, and 136.7 meq/l), K^+ (4.61, 4.52, 4.46 meq/l), Cl^- (98.2, 97.2, and 97.1 meq/l), Ca (9.99, 10.11, and 10.08 mg/dl), and Mg (2.55, 2.42, and 2.50 mg/dl), and urinary pH (8.35, 8.40, and 8.40) and Cl^-:creatinine (4.97, 4.20, and 3.88). Urinary Na^+:creatinine (1.80, 4.21, and 7.42; $P < 0.01$), Ca:creatinine (0.035, 0.041, and 0.064; $P < 0.01$), and Mg:creatinine (0.53, 0.60, and 0.77; $P < 0.01$) increased linearly with increasing the Na:K ratio; whereas, urinary K^+:creatinine decreased linearly as the Na:K ratio increased (22.4, 15.9, and 10.3; $P < 0.01$). Milk performance of mid-lactation cows was similar across dietary Na:K ratios with the same DCAD of 33 meq/100 g of DM.

Key Words: Sodium, Potassium, Performance

512 Fertilization using potassium chloride decreased the DCAD of timothy hay. M. Oba*[1], R. Hohm[2], R. McKenzie[2], and T. Dow[2], [1]*University of Alberta*, *Edmonton, AB, Canada*, [2]*Alberta Agriculture and Food*, *Lethbridge, AB, Canada*.

The objective was to evaluate effects of KCl fertilization on dietary cation-anion difference (DCAD) of timothy (*Phleum pratense* L.) hay. We hypothesized that KCl fertilization would be effective at reducing DCAD of timothy hay. Treatments were fertilization protocols with a 2 × 5 factorial arrangement using two sources of potassium fertilizer (KCl vs. KNO_3) and five rates of application (0, 50, 100, 200, and 400 kg of K/ha), and replicated in two locations: Bow Island and Lethbridge. Soil K concentration (0-15 cm) was greater at Bow Island compared to Lethbridge (293.3 vs. 187.7 ppm). For timothy grown in Bow Island, the K concentration was 1.64, 1.71, 1.69, 1.73 and 1.73 %DM for the K fertilization of 0, 50, 100, 200 and 400 kg/ha, respectively (linear effect: $P < 0.05$). The Cl concentration was increased from 0.20 to 0.93 % (quadratic effect: $P < 0.01$) and DCAD value decreased from 289 to 122 meq/kg DM (linear effect: $P < 0.01$) by KCl fertilization while they were not affected by KNO_3 fertilization. Similarly, in Lethbridge, K concentration of timothy hay was 1.52, 1.61, 1.67, 1.65 and 1.64 %DM for the K fertilization of 0, 50, 100, 200 and 400 kg/ha, respectively (quadratic effect: $P < 0.01$). The Cl concentration was increased from 0.12 to 0.78 % (quadratic effect: $P < 0.01$) and DCAD value was decreased from 237 to 91 meq/kg DM (linear effect: $P < 0.01$) by KCl fertilization. The KCl fertilization increased the K concentration of timothy hay by 5% and 10%, but increased the Cl concentration by 365 and 550 % in Bow Island and Lethbridge, respectively. Consequently, KCl fertilization decreased DCAD of timothy by more than 50% in both locations. Depending on the soil type, KCl may be an alternative and inexpensive source of Cl to produce low-DCAD timothy hay.

Key Words: KCl Fertilization, Timothy Hay, dietary Cation-Anion Difference

513 Timothy hay differing in DCAD value affected Ca homeostasis in periparturient dairy cows. M. Oba*[1], G. B. Penner[1], G. F. Tremblay[2], and T. Dow[3], [1]*University of Alberta*, *Edmonton, AB, Canada*, [2]*Agriculture and Agri-Food Canada*, *Québec, QC, Canada*, [3]*Alberta Agriculture and Food*, *Lethbridge, AB, Canada*.

The objective was to evaluate effects of timothy (*Phleum pratense* L.) hay differing in dietary cation-anion difference (DCAD) on the capability to maintain Ca homeostasis in periparturient dairy cows. We hypothesized that feeding low-DCAD timothy hay to prepartum cows would improve their Ca homeostasis right after calving. Thirty-five dry pregnant cows entering the second lactation or greater were used in a randomized block design. The timothy hay was obtained from an established timothy stand under a pivot irrigation system; $CaCl_2$ was applied to the area between the second and third pivot towers at 224 kg/ha to produce the low-DCAD timothy hay, and control timothy hay was grown on the area between the forth and fifth pivot towers of the same field. The Cl concentration was 1.05 and 0.07% DM, and DCAD value was 45 and 227 meq/kg DM, for low-DCAD and control timothy hay, respectively. Experimental diets, containing timothy hay at 65% of dietary DM (low DCAD vs. control), were fed ad libitum starting 30 d prior to the expected calving date. At the beginning of the study, urine pH and blood bicarbonate concentration averaged 8.24 ± 0.11 and 28.4 ± 0.8 m*M*, respectively. The low-DCAD treatment decreased ($P < 0.05$) urine pH compared to control at 21 d (7.72 vs. 8.34), 14 d (7.70 vs. 8.23), and 7 d (7.68 vs. 8.23) before calving, and decreased ($P < 0.05$) blood bicarbonate concentration 14 d (26.2 vs. 30.3 m*M*) and 7 d (26.9 vs. 30.8 m*M*) before calving. In addition, cows fed the low-DCAD treatment had greater ($P < 0.05$) ionized Ca concentration compared to control at 0 h (1.07 vs. 0.97 m*M*) and 8 h (1.07 vs. 0.99 m*M*) post-calving; the treatment effect disappeared beyond 16 h post-calving. These data indicate that timothy hay differing in DCAD value affects the acid-base balance of periparturient dairy cows, and that low-DCAD timothy hay may prevent postpartum hypocalcemia.

Key Words: Chloride Fertilization, Timothy Hay, Hypocalcemia

514 Effects of hypocalcemia at calving on intake, behavior and 305 milk production. J. M. Huzzey[1], T. F. Duffield[2], S. J. LeBlanc[2], D. M. Veira[3], D. M. Weary[1], and M. A. G. von Keyserlingk*[1], [1]*University of British Columbia*, *Vancouver, Canada*, [2]*University of Guelph*, *Ontario, Canada*, [3]*Pacific Agri-Food Research Centre*, *Agassiz, BC, Canada*.

Sub-clinical disease is often overlooked and rarely treated. The objective of this study was to describe the effects of sub-clinical hypocalcemia occurring shortly after calving on feed/water intake, feeding/drinking behavior and the longer-term effects on milk production. Intake and behavior of 93 Holstein dairy cows were

monitored from 3 wks before until 3 wks after calving. Within 24 h after calving a blood sample was taken from each cow and analyzed for serum total calcium (Ca) concentration. Daily milk yields were collected on each cow until 305 DIM. 28 cows were identified as hypocalcemic on the day of calving (Ca concentration was ≤ 1.8 mmol/L). Hypocalcemic cows had similar intakes to cows without hypocalcemia during the 3 wks before and 2 wks after calving, however DMI was on average 2 kg/d less in the hypocalcemic group during wk 3 (P=0.02). There were no differences in feeding time between the two groups of cows over the course of the study (P=0.2). Cows with hypocalcemia on the day of calving consumed on average 12 kg/d more water during wk 2 and wk 3 after calving relative to cows with normal calcium levels (P≤0.05), but there were no difference between these groups in drinking behavior before or after calving. Hypocalcemic multiparous cows produced more milk during early and mid-lactation (P<0.01). Over the course of their 305 lactation hypocalcemic multiparous cows produced on average 1190 kg more milk then multiparous cows with calcium concentrations >1.8mmol/L on the day of calving (P<0.01). The greater requirements for calcium by cows with higher milk production may explain their increased risk of hypocalcemia and suggests that cows with higher potential may require special treatment.

Key Words: Hypocalcemia, Transition Cows, Feeding Behavior

515 Strong ion concentrations in ruminal fluid of lactating dairy cows fed diets varying in fermentibility. C. S. Mooney* and M. S. Allen, *Michigan State University*, *East Lansing*.

The objective of this experiment was to determine relationships among concentrations of strong ions and hydrogen ions in ruminal fluid of cows fed diets varying in fermentibility. Eight ruminally cannulated Holstein cows in early lactation were used in an experiment with a duplicated 4 × 4 Latin square design. A 2 × 2 factorial arrangement of treatments was used with main effects of dietary starch concentration (32% vs. 21%) and conservation method of corn grain (dry, 90% DM or high-moisture, 63% DM). Ruminal fluid samples (n = 2,304) were collected through a ruminal cannula every twenty minutes for 24 h per period during which feeding behavior and ruminal pH were monitored continuously. Hydrogen ion concentration of ruminal fluid was related negatively to sodium concentration (r = -0.50, P < 0.0001), positively to potassium (r = 0.28, P < 0.0001) and ammonium (r = 0.38, P < 0.0001) concentrations, and not highly related to chloride concentration (r = 0.04, P = 0.09). Change in ruminal potassium concentration was related to meal size (r = 0.83, P < 0.0001) which was expected because of influx of potassium from the diet. However, meal size and ruminal sodium concentration were negatively related (r = -0.64, P < 0.0001) despite influx from saliva and the diet. Sodium concentration of ruminal fluid was negatively related (r = -0.75, P < 0.0001) to the sum of potassium and ammonium concentrations causing the sum of sodium, potassium, and ammonium concentrations to be relatively constant (140.0 ± 9.8 mEq/L, mean ± SD, n = 2246). Hydrogen ion concentration of ruminal fluid was related negatively to strong ion difference measured as ruminal concentrations of sodium plus potassium minus chloride (r = -0.43, P < 0.0001). An alkalizing strong ion difference was measured in all ruminal fluid samples (n=2245). Maintenance of total cation concentration of ruminal fluid balances the charge of dissociated fermentation acids, maintains the bicarbonate pool, and controls ruminal osmolality.

Key Words: Rumen pH, Sodium, Potassium

516 Feed efficiency of lactating dairy cows is related to dietary energy density. D. P. Casper*[1] and D. R. Mertens[2], [1]*Agri-King, Inc.*, *Fulton, IL*, [2]*USDA-ARS Dairy Forage Research Center*, *Madison, WI*.

Monitoring of the Feed Efficiency **(FE)** of lactating dairy cows has become more important in recent years due its direct effect on the profitability of the dairy operation. Our objective was to identify those variables associated with energy metabolism that influence the FE of lactating dairy cows. The Energy Metabolism Database is a compiled dataset of all energy and N balance trials that were conducted at the Energy Metabolism Unit of the USDA-ARS, which contains approximately 2,940 individual energy and N balance digestion trials with measurements of respiratory exchange using open circuit respiration chambers. Only 1,289 of these individual metabolism trials used lactating dairy cows of different breeds and stages of lactation that were fed diets that varied in forage types, grain sources, protein sources, and fat supplements. All data were analyzed using linear regression procedures of SAS. The initial data analysis indicated that ruminal acidosis may have occurred and affected FE results. Thus, metabolism trials of lactating dairy cows having inverted fat and protein ratios (acidosis criteria) where removed, which resulted in 460 observations for evaluating variables related to FE. The amount of dry matter absorbed by lactating dairy cows had a significant effect on FE (FE = 0.46+.067*DM Absorbed, g/d; R^2=.36, *P*<.01). In addition, the greater the energy density of the diet (NE_L, Mcal/kg), the greater the FE of lactating dairy cows (FE = 0.004 + 1.156*NE_L, Mcal/kg DM; R^2=.55, *P*<.01). As expected, FE was positively related to milk production (FE = 0.60 + 0.03*Milk, kg/d; R^2=.77, *P*<.01). It appears that ruminal acidosis negatively effects digestibility thereby affecting the energy metabolism of the lactating dairy cow. Without acidosis, the FE of lactating dairy cows was determined by the energy density of the diet. Improving the energy density of the diet through enhanced dry matter digestibility will improve FE and thereby increase profitability of the dairy operation.

Key Words: Feed Efficiency, Energy Density, Acidosis

517 Factors affecting milk urea nitrogen in dairy cattle. J. Ramírez*[1], D. Lefebvre[2], and K. M. Wade[1], [1]*McGill University*, *Montreal, QC, Canada*, [2]*Valacta*, *Ste. Anne de Bellevue, QC, Canada*.

The aim of this study was to estimate non-nutritional and nutritional factors that influence milk urea nitrogen (MUN) using machine-learning techniques. 2,253,667 milk test-day records were collected by the Quebec dairy herd improvement agency (VALACTA). The files contained test-day, body-weight and diet-composition records of 611,358 cows from 5,886 farms over a period of 5 years. A database was constructed from the animal identification file, test-day file, body-weight, and feed file. Descriptive statistical analysis was performed including breed (Ayrshire, Brown Swiss, Holstein and Jersey), parity, stage of lactation, season, year, and sampling time. Mean MUN values were 12.11, 13.44, 11.06, and 13.8 mg/dL in Ayrshire, Brown Swiss, Holstein and Jersey, respectively. These values decreased with increasing body weight. In Holsteins, MUN levels increased with parity number but parity variations were numerically small. The MUN concentration was lower during the first 30 DIM, but increased in subsequent months. There was a strong negative relationship between MUN and milk yield. Temporal variations suggested a drop in the levels of MUN during the summer followed by a peak during the fall

months. For an analysis using machine-learning techniques, MUN values were grouped into three classes (low, medium, and high). For each of the four breeds, a decision tree was induced to identify potential interactions among the variables in the dataset. Results for the Ayrshire breed indicated that MUN variations were principally due to SCC and time of milk sampling. Body-weight, DMI, and time of milk sampling had a strong influential effect on medium levels of MUN in Jerseys, while MUN levels in Holsteins seemed to be strongly influenced by the interaction of milk fat with SCC and stage of lactation.

Key Words: Milk Urea Nitrogen, Machine Learning, Ddecision Trees

518 The relevance of milk components for the assessment of the energy, protein and structure balance of Holstein Friesian cows. M. Kaske*[1,2], S. Seggewiss[2], K. Horstmann[2], M. Spolders[3], and U. Meyer[3], [1]*Physiology Weihenstephan*, *Technical University Munich*, [2]*Clinic for Cattle*, *University of Veterinary Medicine Hannover*, [3]*Institute of Animal Nutrition*, *Federal Agricultural Research Centre Braunschweig*.

The objective was to characterize the usability of milk component data for the assessment of the alimentary supply of dairy cows. Therefore, the correlations between energy, protein and structure balance and milk constituents (analysed twice per week) were estimated in 50 Holstein Friesian cows (8709 +/- 1472 kg FCM). Cows were fed maize and alfalfa silage (65:35 w/w; 5.9 MJ NEL/kg DM) ad libitum via computerized feeder stations and concentrates (8.3 MJ NEL/kg DM) according to milk yield by automatic feeders. For each cow, daily energy balance [EB], protein balance [PB] (on the basis of nXP) and structure balance [SB] (Hoffmann, 1990) were calculated. The value of the "9-field-table" (used to assess the energy supply based on milk protein and the protein supply based on milk urea) was tested for each month of lactation; a balanced supply was defined as ± 15 MJ NEL/d and +/- 300 g nXP/d. - The EB of the cows was assessed correctly for 30.8–42.7% and the protein balance for 38.5–72.9 % of the samples. Only 13.8–32.2% of the samples were catagorized correctly for both parameters. A significant negative correlation between EB and milk yield was found during the first four months of lactation (r = -0.15 to -0.30); thereafter, EB and milk yield were positively correlated (r = 0.15). EB was negatively correlated to milk fat content (r = -0.16 to -0.54), fat-protein-ratio (r = -0.33 to -0.44) and fat-lactose-ratio (r = -0.28 to -0.59). SB and milk fat were positively correlated (r = 0.24 to 0.28). - The effects of an energy restriction were examined on days 15, 29, 43 and 78 post partum by withdrawal of 8-10 kg concentrates for 24 hours. Milk yield and milk components did not change significantly compared to the days before restriction, but on the following day milk yield and milk protein decreased and milk fat content, fat-protein-ratio and fat-lactose-ratio increased significantly. - Conclusions: Milk fat content and fat-protein-ratio reveal severe energetic and structural deficits only on a herd basis. EB and PB of individual cows can not be assessed reliably by evaluation of milk components.

Key Words: Energy Balance, Milk Components, Milk Protein

519 Evaluation of acute phase reactants and indices of liver function in serum from dairy cows fed different levels of energy prepartum. N. A. Janovick Guretzky*[1], H. M. Dann[1], M. Bionaz[1], E. Trevisi[2], G. Bertoni[2], and J. K. Drackley[1], [1]*University of Illinois*, *Urbana*, [2]*Universita Cattolicà del Sacro Cuore, Zootecnica*, *Piacenza, Italy*.

Markers of inflammation have been associated with fatty liver in dairy cows. To investigate effects of prepartum plane of nutrition on inflammation and liver function, serum from 73 multiparous Holstein cows was used to profile acute phase response reactants and enzymes associated with liver function. Dietary treatments were assigned by expected date of parturition in a 3 x 2 factorial design. During the far-off (FO) period, cows were assigned to 1 of 3 dietary treatments: 1) fed ad libitum to supply ≥150% of NE_L requirements (HI) for dry cows in late gestation (NRC, 2001); 2) fed a diet containing chopped wheat straw to limit intake to approximately 100% of NE_L requirements (LIM); and 3) limit-fed to 80% of NE_L requirements (LO). During the close-up (CU) period, cows were fed ad libitum to supply ≥150% of their requirement for NE_L (ADLIB) or restricted to 80% of their requirement for NE_L (REST). At parturition, all cows were fed a common lactation diet. Data for variables analyzed in serum obtained pre- and postpartum were analyzed using repeated measures. Cows fed HI had lower (FO, $P<0.02$) paraoxanase prepartum compared with LIM or LO. Cows fed HI-REST tended to have higher haptoglobin prepartum than cows fed HI-ADLIB or LO-REST (FOxCU, $P=0.07$). Cows fed HI tended to have lower (FO, $P=0.06$) albumin compared with LIM and higher (FO, $P=0.04$) bilirubin postpartum compared with REST. Cows fed ADLIB had higher (CU, $P=0.04$) aspartate transaminase than REST cows regardless of FO treatment. Concentrations of total lipid and triglyceride in liver postpartum were positively correlated ($P<0.04$) with bilirubin and ceruloplasmin and negatively correlated ($P<0.01$) with paraoxanase measured postpartum. Overfeeding during the dry period may have compromised liver function postpartum and contributed to inflammation and development of fatty liver.

Key Words: Inflammation, Fatty Liver, Periparturient Period

520 Gene expression in adipose tissue of the dairy cow during late pregnancy and lactation fed control diets or diets with supplemental chromium: Integration of gene expression into metabolic models. J. P. McNamara*[1], J. M. Sumner[1], J. L. Vierck[1], and A. Jourdan[2], [1]*Washington State University*, *Pullman*, [2]*Kemin Industries, Inc.*, *Des Moines, IA*.

We conducted an analysis of gene expression in adipose tissue of dairy cattle in late pregnancy and early lactation. One objective was to determine gene expression between 30 days prepartum and 30 DIM; another was to determine if dairy animals fed supplemental Chromium Propionate had responses gene expression. Adipose tissue was biopsied from Holstein dairy cattle at 30 days pre and post partum. We extracted complete mRNA from samples from 3 cows at each time point (same cows, repeated measures) for gene array analysis. Among those genes increasing ($P < 0.10$) to 30 DIM were those signaling for myosin heavy chain, several immunoglobulins and receptors, and neutrophil beta-defensin 5. Among those decreasing ($P < 0.10$) from 50 to over

75 % included acetyl CoA Carboxylase (-79 %), ATP citrate lyase (-75 %), insulin receptor induced protein (-77 %), IGFI (-30 to 50%), and IGFBP3 (-55 %). Leptin expression (Genbank: NM_173928.1) was reduced 57 %. In a separate study, we fed 10 mg/d of chromium from 21 d prepartum through 35 DIM. There were 223 genes that were increased 2-fold or more at d -7 versus controls, and 1150 were decreased 50% or more compared to control. There were 3517 genes lower in supplemented cows in which at least one of the signals had an expression of 50 or more on the Affymetrix chip. There were 24 genes that increased and 347 that decreased in CrP supplemented animals at both days. The primary functional cluster of genes that were up regulated in supplemented animals included those functioning in cell synthesis and in the immune system, such as myosin heavy chain and immunoglobulin A receptor. Genes decreased at both times to chromium were NADH dehydrogenase, t-cell receptor, and prostaglandin PGH2. Leptin expression was decreased by KT at d 28, as was growth hormone receptor mRNA. We have integrated a preliminary gene expression map with a mechanistic model of metabolism in dairy cattle.

Key Words: Adipose, Gene Array, Lactation Model

Ruminant Nutrition: Corn Milling Co-Products - Beef

521 Environmental concerns with feeding corn milling co-products in feedlot diets. T. J. Klopfenstein* and G. E. Erickson, *University of Nebraska*, *Lincoln*.

The grain to ethanol industry is rapidly expanding which creates challenges and opportunities for the cattle feedlot industry. This expansion creates competition for grain; however, byproducts may offer opportunities to reduce costs of production. Meta analysis indicates that wet distillers grains have 25 to 45% more feed value than corn and wet corn gluten feed has equal to or 9.4% more energy than corn depending on the plant processes. Priced at or below the price of grain, byproducts are economically advantageous to the feedlot industry. Ethanol is produced from the starch in grain so by removing the starch, nutrients are concentrated in the byproducts (three times in distillers grains). The two nutrients of concern, from an environmental standpoint, are N & P. Nitrogen is a concern primarily because it is volatilized from the surface of open feedlot pens. Alternatively, P is not volatilized...what the cattle excrete is what must be managed in the manure. A diet containing 40% distillers grains on a dry basis has about 18% CP which is about 50% above the animal's requirement. All of the excess N is excreted. A diet with 40% gluten feed is near the animal's requirement for CP. Byproduct diets are less digestible than corn based diets and the additional OM in the manure helps retain some of the excess N. Frequent cleaning is also beneficial. There is still a net loss of N as ammonia. A diet with 40% byproduct has about 0.5% P which is about three times the requirement. This essentially doubles the land necessary to utilize the manure compared to a corn-based diet. For a 25,000 hd feedlot that may add $2 to $3 per animal to distribute the manure. However, because of the value of the P as fertilizer there is actually a net benefit of $3 to $5 per animal fed. Phosphorus is a distribution issue with byproduct feeding, not a negative economic issue. While ammonia loss from open feedlots is not currently regulated, it may be in the future. Methods of maintaining the N in the manure to capture its value as fertilizer need to be researched for both diets with and without byproducts.

Key Words: Cattle Feeding, Nitrogen, Phosphorus

522 Effect of modified wet distillers grains level on feedlot cattle performance and nitrogen mass balance. M. K. Luebbe*, G. E. Erickson, T. J. Klopfenstein, and M. A. Greenquist, *University of Nebraksa*, *Lincoln*.

A summer feedlot trial was conducted to evaluate the impact of modified wet distillers grains plus solubles (52% DM, WDGS) level on steer performance, manure N removed, and N lost via volatilization. Ninety-six yearlings (373 ± 24 kg) were stratified by BW and assigned randomly to 12 pens. Steers were fed for 133 d from June to October. Treatments consisted of 0, 15, and 30% dietary inclusion of WDGS (DM basis) replacing corn (CON, 15WDGS, 30WDGS, respectively). Basal diets consisted of high-moisture and dry-rolled corn fed at a 1:1 ratio, 7.5% alfalfa hay, 5% molasses, and 5% supplement (DM basis). The CON and 15WDGS diets were balanced for MP using the 1996 NRC, and 30WDGS was in excess of requirements. Nitrogen excretion was determined by the difference between N intake and individual steer N retention. Total N lost was calculated by subtracting manure and runoff N from excreted N. Dry matter intake tended ($P=0.09$) to increase linearly with WDGS level. Average daily gain was lower ($P=0.05$) for CON compared with 15 and 30 WDGS (1.80, 1.94, and 1.91 kg, respectively). Carcass measurements, G:F, and final BW were not influenced ($P>0.10$) by WDGS level. Manure OM linearly increased ($P=0.02$) with WDGS level. Nitrogen intake was greatest ($P<0.01$) for 30WDGS, intermediate for 15WDGS, and least for CON (42.9, 35.5, and 28.9 kg•steer^{-1}over 133 d, respectively). Nitrogen retention did not differ ($P=0.16$) among WDGS level. Excretion of N was greatest ($P<0.01$) for 30WDGS, intermediate for 15WDGS, and least for CON (38.0, 30.5, and 24.3 kg, respectively). Manure N was greater ($P<0.01$) for 30WDGS (10.2 kg) compared with 15WDGS (6.5 kg) and CON (5.8 kg). Runoff N was not different ($P=0.54$) among WDGS level. Amount of N lost was greatest ($P<0.01$) for 30WDGS, intermediate for 15WDGS, and least for CON (26.5, 20.0, and 14.1 kg, respectively) but percent loss (percent of excreted N) was not different ($P=0.32$) among treatments. In this study feeding WDGS balanced for MP or in excess of requirements resulted in improved ADG and more N in the manure for 30WDGS. However, the amount of N lost was increased when WDGS was fed.

Key Words: Cattle, Nitrogen, Waste Management

523 Effect of wet distillers grains level on phosphorus balance in beef feedlots. M. K. Luebbe*, G. E. Erickson, T. J. Klopfenstein, and M. A. Greenquist, *University of Nebraska*, *Lincoln*.

The effect of wet distillers grains plus solubles (WDGS) level on P mass balance was evaluated in two experiments. Calves were fed 167 d from November to May (WINTER) and yearlings were fed 133 d

from June to October (SUMMER). Treatments consisted of 0, 15, and 30% dietary inclusion of WDGS (DM basis) replacing corn (CON, 15WDGS, 30WDGS, respectively). Modified WDGS was fed in the SUMMER experiment. Basal diets for both experiments consisted of high-moisture and dry-rolled corn fed at a 1:1 ratio, 7.5% alfalfa hay, 5% molasses, and 5% supplement (DM basis). Mass balance of P was evaluated by measuring P in diets, manure, soil on the pen surface, and runoff. Dietary treatments were fed in the same pens for both experiments. Diet P composition (DM basis) averaged 0.34, 0.39, and 0.47% in both experiments for CON, 15WDGS, and 30WDGS, respectively. When WDGS was fed, P intake linearly increased (P<0.05) for both experiments. Retention of P linearly increased (P<0.05) with WDGS level in the WINTER trial due to ADG response but was not different (P=0.16) among WDGS levels for the SUMMER trial. Excretion of P linearly increased (P<0.01) in both experiments with 3.88, 5.13, and 6.37 kg •steer^{-1} in the WINTER and 3.77, 4.62, and 5.76 kg •steer^{-1} excreted in the SUMMER for CON, 15WDGS and 30WDGS, respectively. Similarly, manure P linearly increased (P<0.01) with 2.77, 3.82, and 4.49 kg •steer^{-1} in the WINTER and 2.05, 2.57, 4.32 kg •steer^{-1} in the SUMMER for CON, 15WDGS and 30WDGS, respectively. Correcting manure for soil P accounts for 98, 79, and 102% of excreted P in the WINTER and 87, 62, and 57% of excreted P in the SUMMER for CON, 15WDGS, and 30WDGS, respectively. Runoff P was not different (P>0.10) among WDGS level and averaged 3.8, and 9.5% of excreted P for WINTER and SUMMER, respectively. These results suggest that increasing dietary P will increase manure P and the amount of land needed for manure application when WDGS are used by feedlot cattle.

Key Words: Cattle, Phosphorus, Nutrient Management

524 Evaluation of dried distillers grains or soybean hulls with and without Optigen II® to background beef calves. J. L. Wahrmund* and M. J. Hersom, *University of Florida*, *Gainesville*.

The objective of this study was to determine the effects of supplementing a controlled-release source of DIP (Optigen) when feeding dried distillers grains (DDG) or soybean hulls (SBH) to weaned beef calves. Fifty-six Angus steers (initial BW=236 ± 25 kg) were blocked by BW and randomly allotted to one of four supplement treatments. Treatments included: 1) 1.19 kg DDG (0.82 kg CP, 2.4 kg TDN); 2) 1.19 kg DDG, 45.5 g Optigen (1.11 kg CP, 2.4 kg TDN); 3) 2.63 kg SBH (0.83 kg CP, 4.7 kg TDN); 4) 2.63 kg SBH, 45.5 g Optigen (1.11 kg CP, 4.7 kg TDN). Amounts of DDG and SBH were formulated to supply equal CP. Optigen was included to determine the effect of a slow-release DIP source in these diets. All steers were allowed ad libitum access to bahiagrass hay and individually supplemented via a Calan Gate system for 42 d. On d 0, 14, 28, and 42 BW was recorded and a blood sample was collected for analysis of plasma urea nitrogen (PUN) and glucose concentration from all steers. Supplement treatment had no effect on final BW (P=0.97, mean=273 kg). 42 d ADG did not differ (P=0.17, mean=0.88 kg/d) among treatments. No differences in plasma glucose concentrations were observed (P=0.54, mean=69.2 mg/dL) between supplement treatments. PUN concentrations exhibited a treatment x day interaction (P=0.001). On d 14, 28, and 42 steers consuming only DDG had greater (P<0.05) PUN concentrations than steers consuming only SBH (10.3 vs. 8.6 mg/dL). Additionally, on d 14, 28 and 42 steers consuming Optigen had increased (P<0.05) PUN concentrations compared to steers not offered Optigen (11.6 vs. 8.5 mg/dL). On d 14 and 42, PUN concentration did not differ (P=0.45, 0.77) between DDG and SBH+Optigen steers. The inclusion of a controlled-release DIP source did not affect steer performance. However, Optigen was effective at increasing PUN concentrations above 10 mg/dL, indicating adequate DIP for forage fermentation within the rumen.

Key Words: Steers, Supplementation, Protein

525 Carcass and meat quality characteristics of distiller's co-product-supplemented pasture- and feedlot-finished beef steers. R. C. Knock*[1], A. H. Trenkle[1], E. J. Huff-Lonergan[1], S. M. Lonergan[1], J. R. Russell[1], P. M. Dixon[1], K. M. Carnagey[2], and D. C. Beitz[1], [1]*Iowa State University*, *Ames*, [2]*Wake Forest University School of Medicine*, *Winston-Salem, NC*.

British breed beef steers (n = 48; 370 kg) were assigned to pasture or feedlot diets and one of two concentrations of 25-hydroxyvitamin D_3 (VITD; 0 or 500 mg) to evaluate VITD and distiller's co-product supplementation effects on performance, carcass traits, and fatty acid composition. Pasture-finished cattle received 6.8 kg/hd per day of pelleted distiller's grains, wheat midds, and soy hulls. The feedlot diet contained 10% wet distiller's grains. Steers were harvested after 112, 133, or 154 d on feed (DOF) to minimize 12th rib fat differences. Steers (n = 24) received 25-hydroxyvitamin D_3 boluses orally 7 d prior to assigned harvest date. At harvest, carcass data and longissimus (LM), semimembranosus (SM), and gracilis (GR) muscles were collected for analysis. At harvest, feedlot steers were heavier (P = 0.0370; 584 kg; 132 DOF) than pasture-fed steers (563 kg; 130 DOF) and had greater ADG (P < 0.0001; 1.74 vs. 1.51 kg/d). Pasture-fed steers had less (P < 0.0001) 12th rib fat and (P = 0.0108) kidney, pelvic, and heart fat as well as lower (P = 0.0141) marbling scores than did feedlot steers (Slight^{45} vs. Slight^{90}). Lipid percentage differed by muscle (P < 0.0001) as GR had the least lipid followed by SM and LM (1.54, 1.94, and 2.54% of tissue, respectively). Pasture-fed steers had greater LM C18:2 cis-9, trans-11 (CLA) and C18:3n3 concentrations (P < 0.0001) than did feedlot steers (0.95 and 0.63 vs. 0.19 and 0.26 mg/100 mg lipid, respectively). Feedlot steers generally had greater monounsaturated fatty acid percentages, except for C18:1 trans-9 and trans-11 isomers. VITD did not affect performance or carcass traits. Data indicate it is possible to finish steers on pasture by supplementing with distiller's co-products without substantially increasing time needed to reach market weight and still maintain increased CLA compared with feedlot-finished steers.

Key Words: Beef, Distiller's Grains, Pasture-Finished

526 Evaluation of dried distillers grains or soybean hulls to background beef calves. J. L. Wahrmund* and M. J. Hersom, *University of Florida*, *Gainesville*.

The objective of this study was to determine the effects of supplementing dried distillers grains (DDG), soybean hulls (SBH), or combinations of the two to beef steers consuming low quality hay. Fifty-six Angus steers (initial BW=275 ± 27 kg) were blocked by BW and randomly allotted to one of four supplement treatments. Treatments included: 1) DDG (2.8 kg); 2) DDG/SBH (1.93 kg DDG, 0.98 kg SBH); 3) SBH/DDG (0.96 kg DDG, 2.05 kg SBH); 4) SBH (3.12 kg).

Supplements were formulated to be isoenergetic, and steers were individually supplemented via a Calan Gate system for 42 d. All steers were allowed ad libitum access to bahiagrass hay. On d 0, 14, 28, and 42 BW was recorded and a blood sample was collected for analysis of plasma urea nitrogen (PUN) and glucose concentration from all steers. Supplement treatment had no effect (P=0.79) on final BW (mean=306 kg). From d 0 to 14, ADG of DDG steers was 0.27 kg/d less (P<0.05) compared to treatments containing SBH (mean=0.60 kg/d). Across all 42 d, ADG of SBH steers was less than DDG/SBH (P=0.06, 0.80 kg/d) or SBH/DDG (P=0.03, 0.83 kg/d), but was not different (P=0.45) than DDG steers (0.72 kg/d). Plasma glucose concentrations were not different (P=0.85, mean=77.98 mg/dL) between supplement treatments. PUN concentrations exhibited a treatment × day interaction (P=0.01). On d 0, PUN concentration did not differ (P=0.65, mean=6.4 mg/dL) between treatments. However, on d 14, 28, and 42 PUN concentrations of DDG and DDG/SBH steers (15.87, 13.98, 12.51 and 11.47, 11.67, 12.79) were greater (P<0.05) compared to SBH/DDG or SBH steers (9.49, 8.45, 9.57 and 5.25, 5.46, 5.91). Supplementing steers consuming low-quality forage with a combination of co-products resulted in improved BW gain and nitrogen metabolism. The combination of 0.9 kg DDG and 2.05 kg SBH optimized calf performance.

Key Words: Steers, Supplementation, Co-Products

527 Effect of wheat base distillers grains in a barley ration on the performance and carcass quality characteristics of feedlot steers. R. M. Beliveau*, J. J. McKinnon, and V. J. Racz, *University of Saskatchewan*, *Saskatoon, Saskatchewan, Canada*.

The objective of this experiment was to evaluate the effects of titrated levels of wheat-based dried distiller's grains with solubles (DDGS) on feedlot performance and carcass characteristics of growing cattle. Two hundred weaned calves (290±5kg) were randomly assigned to one of 20 pens and fed one of 5 DDGS treatments. During backgrounding, the barley grain-based control diet was formulated to 12% CP, 28% RUCP, 1.52 and 0.93 Mcal / kg NE_m and NE_g, respectively. In treatments 2 through 5, DDGS replaced barley grain at levels of 8.1, 16.2, 24.2 and 32.1% of the ration dry matter. The finishing barley grain-based control diet was formulated to 12% CP, 27% RUCP, 1.90 and 1.26 Mcal / kg NE_m and NE_g, respectively. DDGS replaced barley grain in treatments 2 through 5 at levels of 5.9, 11.7, 17.5 and 23.3% of the ration dry matter. Crude protein and RUCP levels increased in a linear fashion as DDGS inclusion level increased. The backgrounding period lasted 85 d. The targeted end-point for finishing was a shrunk body weight of 600 kg. During the 85 d backgrounding period, ADG and DMI increased (P≤0.01) quadratically as DDGS inclusion level increased. Feed efficiency was significantly improved (P≤0.05) at the 2 highest levels of DDGS inclusion. During the first 56 d of finishing there was a linear increase (P≤0.05) in ADG and a cubic increase in DMI as DDGS inclusion level increased, however over the entire trial there was no (P≥0.05) ADG response to DDGS inclusion. Ultrasound backfat and ribeye area measurements were not (P≥0.05) affected by treatment. Similarly, carcass weights and quality traits including dressing percentage, marbling, fat thickness and yield grade were not influenced (P≥0.05) by treatment. The results of this trial indicate that for feedlot cattle, the energy value of wheat-based DDGS is at least equal to that of barley grain with no adverse effects observed on cattle performance or carcass quality.

Key Words: Wheat-Based Dried Distiller's Grains, Cattle, Barley

528 Dry distiller's grains with solubles in steam-flaked or dry-rolled corn diets with reduced roughage levels. M. L. May*, M. L. Hands, M. J. Quinn, B. E. Depenbusch, J. O. Wallace, C. D. Reinhardt, and J. S. Drouillard, *Kansas State University*, *Manhattan*.

A study was conducted to evaluate the use of 25% dry corn distiller's grains with solubles (DG) as a partial replacement for dry-rolled corn or steam-flaked corn in finishing diets containing either high (15%) or low (5%) levels of corn silage (CS). Crossbred heifers (n=582; BW 377 ± 0.4 kg) were housed in 24 dirt surfaced pens with 21-25 heifers per pen and fed finishing diets once daily for 110 d. Experimental diets were: steam-flaked corn without DG and 15% CS (SFC), SFC with 25% DG and 15% CS (SFCHigh), SFC with 25% DG and 5% CS (SFCLow), dry-rolled corn with no DG and 15% CS (DRC), DRC with 25% DG and 15% CS (DRCHigh), and DRC with 25% DG and 5% CS (DRCLow). Within grain source, DMI were similar for cattle fed 0 and 25% DG. The 5% CS groups consumed less feed daily and also were more efficient. Yield grade and carcass quality were not affected by inclusion of DG. Results indicate that roughage levels can be reduced in feedlot diets containing DG with no adverse effects on efficiency, health, or carcass quality.

Table 1. Performance of cattle fed steam-flaked or dry-rolled, reducing roughage levels, and with or without disitller's grains

Item	DRC	DRC High	DRC Low	SFC	SFC High	SFC Low	Contrasts 1	2	3
DMI, kg	8.37	8.38	7.78	8.08	7.70	7.16	<0.01	<0.01	<0.01
F:G	0.138	0.141	0.151	0.156	0.155	0.166	<0.01	0.02	0.01
Choice, %	56.89	62.86	61.11	66.94	67.98	61.64	NS	NS	NS
Yield grade	2.59	2.65	2.66	2.54	2.42	2.54	0.02	NS	NS

Contrast 1:Dry-rolled vs. Steam-flaked; Contrast 2: 25% DDG with 15% CS vs. 25% DDG with 5% CS; Contrast 3: 0% DDG and 15% CS vs. 25% DDG and 5% CS

Key Words: Steam-Flaked Corn, Dry-Rolled Corn, Dry Distiller's Grain

529 Use of distiller's dry grains in steam-flaked corn finishing diets with reduced roughage levels. M. L. May*, M. J. Quinn, B. E. Depenbush, and J. S. Drouillard, *Kansas State University*, *Manhattan*.

A finishing study was conducted to evaluate the use of dry corn distiller's grains (DDG) in steam-flaked corn (SFC) diets, and to examine the potential for reducing the level of Corn Silage (CS) when DDG is substituted for a portion of SFC. Crossbred heifers (n=377; BW 378±1.4 kg) were fed diets consisting of 0% DDG with 15% CS (CON), 25% DDG with 15% CS (HIGH), or 25% DDG with 5% CS (LOW). Heifers were individually weighed and assigned randomly to feedlot pens containing 15 to 16 animals each, with eight pens per treatment. Heifers were fed twice daily ad libitum for 85 d. There were no differences among treatments with respect to ADG, G:F, final weight, carcass weight, subcutaneous fat thickness, carcass quality grade, or yield grade (P > 0.10). Compared to cattle fed the CON diet, heifers fed LOW had decreased DMI (9.01 vs. 8.52 kg/d) and higher dressing percentage (63.23 vs 63.73%). Inclusion of DDG with 15%

CS reduced LMA when compared to CON (86.1 vs 82.5 cm^2; P < 0.04). Partial replacement of SFC with DDG yields satisfactory performance and carcass characteristics in cattle fed diets with CS as the roughage source. Additionally, it is possible to remove a significant portion of dietary roughage in diets containing DDG without compromising performance.

Table 1. Performance ofheifers fed steam-flaked corn with dry distiller's grains with reducing roughage levels

					Contrasts		
Item	CON	HIGH	LOW	SEM	1	2	3
DMI, kg	9.01	8.77	8.52	0.16	NS	0.05	NS
G:F	0.146	0.148	0.151	0.59	NS	NS	NS
HCW, kg	312	309	309	3.20	NS	NS	NS
Prime/Choice, %	55.89	62.24	61.93	4.11	NS	NS	NS
Yield grade, avg	2.62	2.74	2.66	0.07	NS	NS	NS
Yield grade 4 & 5, %	5.68	14.12	11.09	3.13	0.07	NS	NS

Contrast 1: 0% DDG and 15% CS vs. 25% DDG and 15% CS; Contrast 2: 0% DDG and 15% CS vs.25% DDG and 5% CS; Contrast 3: 25% DDG and 15% CS vs. 25% DDG and 5% CS

Key Words: Steam-Flaked Corn, Finishing Cattle, Dry Distiller's Grains

530 Effect of crude glycerin in finishing cattle diets. N. A. Pyatt, P. H. Doane, and M. J. Cecava*, *ADM Animal Nutrition Research*, *Decatur, IN*.

One hundred fifty-eight Angus-cross steers (387.4 ± 1.6 kg) were used in a 2 × 2 factorial to assess the effects of diet type (grain or co-product) and crude glycerin on feedlot performance. The grain diet consisted of (DM basis) 70% cracked corn, 15% corn silage, 10% DDGS, and 5% supplement; the co-product diet consisted of 35% cracked corn, 30% DDGS, 15% soyhulls, 15% corn silage, and 5% supplement. Glycerin replaced 0 or 10% corn in both diet types. Cattle were blocked by weight (4 pens per treatment), weighed at 28-d intervals, and processed at a constant backfat endpoint (116 to 153 d on feed). Period and cumulative (d 1-116 and 1-153) data were analyzed. No significant (P>0.10) interactions were observed. Cumulative ADG was 11.4% greater in cattle fed grain diets with glycerin and 2.5% better for steers fed co-product diets with glycerin. Cattle fed co-product diets had 9.7% greater (P<0.05) DMI relative to cattle fed grain diets (8.74 vs. 9.59 kg/d, respectively). Feeding glycerin resulted in 10.1% lesser (P<0.05) DMI (9.65 vs. 8.68 kg/d, respectively). Glycerin decreased DMI by 8.1% for the grain diet and 11.8% for the co-product diet. Feed efficiency was 11.0% greater (P<0.05) for cattle fed grain diets versus co-product diets. Glycerin improved feed efficiency by 19.2% (P<0.05). Feed efficiency improved by 21.9% and 16.4% when glycerin was fed in the grain and co-product diets, respectively. These data suggest that feeding crude glycerin can improve efficiency of cattle fed high-grain diets. Furthermore feeding crude glycerin in combination with co-products like DDGS and soyhulls may diminish feed intake but improve feed efficiency.

Key Words: Feedlot Cattle, Crude Glycerin, Co-Products

531 The effect of forage allowance and stage of growth on average daily gain, frothy bloat, and rate of ruminal in vitro gas production in steers grazing wheat pasture. W. E. Pinchak*[1], B. R. Min[1], D. P. Malinowski[1], J. W. Sij[1], J. D. Fulford[1], and R. Puchala[2], [1]*Texas Agricultural Research Center*, *Vernon, TX85*, [2]*E (Kika) dela garza American Institute for Goat Research Center*, *Langston, OK*.

A combination of grazing and in vitro experiments were conducted over 3 yrs. to determine the effect of plant chemical composition, forage allowance and two stages of growth on the severity of bloat and ADG in steers grazing wheat forage. Concurrently, in vitro ruminal gas production was quantified at the same time of bloat measurement. Wheat forage protein dynamics, related with forage allowance and plant stage of growth, are presented. ADG was greater for high forage allowance than for low forage allowance during yr 2004 ($P < 0.01$) and 2005 ($P < 0.001$). Mean bloat score tended to differ with forage allowance during vegetative ($P = 0.07$) and reproductive ($P = 0.16$) stages of growth. Across the yrs, average percentage of bloated steers in the low forage allowance treatment was consistently less (21 vs. 45%; $P < 0.001$) than in animals grazing the high forage allowance treatment. Bloat frequency on wheat forage is temporally variable with most frothy bloat occurring during the vegetative stage of growth (32%) compared to the reproductive stage of growth (13%). Frothy bloat negatively effected (r = -0.37 to -0.54; $P < 0.001$) and linearly decreased ($P < 0.001$) ADG in steers grazing wheat forage. Average in vitro potential gas and methane production were greater ($P < 0.001$) for the reproductive stage of growth than for vegetative stage of growth. Wheat forage bloat is a complex disorder that varies across stage of plant growth, forage allowance and experimental yrs. Frothy bloat negatively impacts ADG and animal performance.

Key Words: Average Daily Gain, Frothy Bloat, Gas Production

Teaching/Undergraduate & Graduate Education: Shaping Animal Sciences Curricula for 2020

532 Animal sciences curricula: A historical perspective. J. A. Sterle*, *Texas A&M University*, *College Station*.

When the Land Grant University system was officially started at the time President Lincoln signed the Morrill Act in 1862, animal husbandry courses were already being taught at various colleges and universities across the country. Soon, individual courses began to develop into series, and series into an overall curriculum. Originally set up to teach farmers' and ranchers' sons new technological advancements so they could return to the ranch, courses included nutrition, animal breeding and reproductive physiology. Curricula in animal science departments across the nation has developed, ebbed and flowed over time in response to a variety of factors. "Husbandry" became "science", and not in name only. New disciplines, from ethology to genomics, and new technology, from molecular biology techniques to artificial insemination brought about new courses and new requirements in

degree plans. Departments of Animal Science, Dairy Science, and Poultry Science faced the decision of whether to remain separate entities or join together. Capstone courses became popular in the 1990s, bringing together concepts and information from multiple courses, bridging gaps between them. Changing demographics influenced courses as well. These changes not only included the addition and eventually acceptance of women in the animal science field, but also the more recent influx of students with little to no animal agriculture background. This latest change is currently forcing many departments to go "back to the basics", and teach students things that were previously assumed known, such as how to handle livestock, or explaining more of the "whys" of production practices, instead of only the "hows". Career opportunities have also influenced curricula. Instead of graduating and moving back home to take over the family operation of producing food and fiber, today's graduates choose from a huge variety of professions previously unheard of, including the feeding or pharmaceutical industries, meat science and food safety, and public policy. Professional school opportunities are also accepting more animal science graduates than previously, including veterinary, medical, dental and law school.

Key Words: Teaching, Curricula

533 Changing demographics and enrollment trends. K. L. Esbenshade*, *North Carolina State University*, *Raleigh*.

The demographics of the population in the US are shifting resulting in changes in the composition of students attending higher education (HE) and studying agriculture and related subjects. Between 1900 and 2000, the US population living in metropolitan areas increased from 28% to 80%, the average age increased from 22.9 to 35.3 years, and the percent non-white increased from 12 to 25. The US foreign-born population was 13.6% in 1900, 4.7% in 1970 and 7.9% in 1990. Before 1960, more than 80% of the immigrants were European, after which the majority of immigrants were from Latin America and Asia. The current distribution of non-whites is not equal among the states, with southern and western states being more diverse. The number of high school graduates peaked in 1978 and has remained steady during the past decade averaging 2.7 million students annually. Between 1970 and 2000, enrollment and degrees awarded in HE increased 78% and 72%, respectively, with associate, bachelor (B), master (M) and doctoral (D) degrees increasing, respectively, 129%, 48%, 103% and 40%. In 2004, 14.8 million undergraduate students were enrolled and 1.4 million B degrees awarded. Between 1976 and 2004, B degrees awarded to females increased from 46% to 59%, to minority students from 17% to 34%, and to nonresident aliens from 2% to 3%. Between 1970 and 2000, the number of B, M and D degrees awarded in agriculture and natural resources (ANR) increased 84%, 74% and 4%, respectively, representing 1.9% of the total B degrees awarded in 2000. ANR B degrees awarded to females were 4% in 1970 and 45% in 2000, and to minority students were 9% in 1991 and 11% in 2003. The number of B degrees in animal science (ANS) increased 27% between 1987 and 2003 representing 17% of ANR degrees in 2003. B, M and D degrees awarded to females in ANS were, respectively, 70%, 53%, and 34% in 2002. The demographic trends in the US are projected to continue with the population becoming older, more diverse and living in major metropolitan areas. HE, ANR and ANS must adapt their academic programs to be relevant and to serve these populations in the future.

Key Words: US Demographics, Enrollment, Students

534 Curricular trends: Shifts in traditional animal sciences courses and degree programs. J. C. Swanson* and D. A. Nichols, *Kansas State University*, *Manhattan*.

During the past 20 years dramatic changes have taken place in animal agriculture. Concurrent with this change has been shifts in the demographic of students entering into the animal sciences. Scientific discoveries and development of technologies in the animal sciences have widened the scope of opportunity beyond the traditional staples offered in animal science teaching programs. For example, some departments have introduced a biotechnology option for students desiring a career path that could lead to employment in different scientific communities. Companion animal science, equine science, zoo or exotic animal biology and management, and food safety and biosecurity are examples of emerging areas where students desire to apply their animal science training. The current focus on animal care, welfare assessment, and auditing may offer placement opportunities for students in food animal production programs, government animal care assurance, or in biomedical research facilities. Animal science departments should consider the unique niche it occupies in the understanding of the biology, care, production, and management of animals under domestic or captive conditions. Also, regional differences in student demographics and stakeholder needs play a role in curricular development or revision. We are not proposing an abandonment of current livestock and poultry curricula. We propose to extend our expertise in the understanding and management of animals, and the related development and application of science and technologies, for students interested in alternative career paths.

Key Words: Animal Science, Curriculum, Trends

535 Thinking outside of the box: Incorporating innovative experiential & inquiry-based learning opportunities. J. N. Spain*, *University of Missouri*, *Columbia*.

Student learning is accomplished through a wide array of teaching methods. Lectures and note-taking is a staple approach applied in large and small courses. In animal agriculture, we have an opportunity to incorporate active engagement of students through experiential and inquiry-based learning. The use of teaching farms allows instructors to take advantage of place based learning that allows students to connect new knowledge to several senses. The ability of instructors to challenge students to apply knowledge and facts to problems that are real life scenarios gives students a learning advantage. Indeed, experiential learning can be incorporated into the curriculum from first semester introductory courses through capstone courses that utilize student managed teaching herds and flocks. Challenging students through learner driven inquiry-based learning is also effectively incorporates into animal/dairy/poultry science curriculum. One prime example is undergraduate discovery research which allows the student to experience the research process. Another example of inquiry based learning involves the use of bioethics based courses. Experiential and inquiry based learning is effectively used to enhance student learning and understanding.

Key Words: Experiential Learning, Inquiry Based Learning, Animal Science

536 Thinking outside the box: Linkages with agencies and educational opportunities for undergraduates and graduate students. M. A. Ottinger*, *University of Maryland*, *College Park*.

The range of career paths and training requirements has become increasingly complex in the animal sciences. As a result, our students often spend most of their time in the classroom and some highly motivated students seek experience at veterinary clinics to meet the criteria for acceptance to professional school. Experiential learning and internships provide opportunities for broadening the experiences of our students outside the classroom. Internships in agriculture related organizations, which may be involved in research, policy, or many other potential activities provide wonderful opportunities for our students to deepen their understanding of the demands of various careers. At the University of Maryland, our students can work with numerous federal and state agencies, other universities, and private corporations. Working relationships with these entities may be on many levels, including MOUs, centers, adjunct faculty, or informal collaborations. Student internships may be for academic credit, as volunteer or paid positions. It is critical that these experiences have some type of structure to ensure high quality and commitment by student and the agency mentor. The types of positions and several methods for structuring this program will be discussed, including establishing MOUs and consideration of appropriate work demands and deliverables from the student. These partnerships with scientists and professionals in regional federal and state agencies can provide benefits for our students, including extending their technical capabilities and providing experience in a range of potential career choices. These experiences will encourage our young scientists to become enthusiastic contributors to agricultural sciences and energize them in interesting career paths in global agricultural programs. Furthermore, networking with our international collaborators will keep us on the cutting edge of international advances in agriculture and in affiliated disciplines.

Key Words: Experiential Learning Opportunities, MOUs with Agencies, Internships and Academic Credit for Student Interns

537 Animal sciences curricula: Future directions. T. Field*, *Colorado State University*, *Fort Collins*.

The fortunate reality of offering a futuristic perspective is that we are rarely held to account for our predictions. Nonetheless, our profession and our students will be faced with one certainty - change. Demand for food, fiber, and other products originating from livestock and poultry will increase on a global scale. Concurrently, consumers will demand higher value, more convenience, better food safety, environmental compatability, and evidence of excellent animal husbandry in our production practices. The opportunities for graduates of animal, dairy, and poultry science programs will continue to diversify as will the availability of enhanced tools and technologies that can be applied in the industry. Practioners of our craft in the future will have to successfully merge biological, financial, public policy, marketing, and human resources skills to be successful in the future. While technical training will continue to be an important focus of our teaching efforts, our students will not be well prepared for the challenges that will confront them unless they receive an education that is also broad in scope - particularly at the bachelors and masters levels. Curriculum design must also accomodate training that moves students beyond disciplines and into the realm of systems thinking and multi-disciplinary problem solving. Effective curricula will contain significant experiential learning opportunities, case-based course design, and international study. The challenge of the future will be to find the optimal balance of rigor, depth, breadth, and customization in the development of a course of study.

Key Words: Future, Curricula, Students

Growth and Development - Livestock and Poultry II

538 Ontogenic expression of microRNA in bovine mammary gland. A. V. Capuco*[1], L. L. Coutinho[2], C. M. Evock-Clover[1], A. Minuti[3], T. S. Sonstegard[1], Y. R. Boisclair[4], M. E. Van Amburgh[4], G. Bertoni[3], and L. K. L.K. Matukumalli[1], [1]*Bovine Functional Genomics Laboratory, USDA-ARS*, *Beltsville, MD*, [2]*University of Sao Paulo-ESALQ*, *Piracicaba, SP, Brazil*, [3]*Institute of Zootechnics, Catholic University*, *Piacenza, Italy*, [4]*Cornell University*, *Ithaca, NY*.

MicroRNAs (miR) are small RNA molecules (~22 nucleotides) that are important regulators of numerous biological processes, including organ and tissue morphogenesis and function. In this capacity, most miR inhibit protein synthesis by binding to the 3′-untranslated region of targeted mRNA species. Hundreds of genes can be regulated in this fashion. The objective of this experiment was to evaluate expression of miR in mammary tissue from Holstein cows at different developmental and functional stages. Tissues were obtained from: prepubertal heifers (6 mo) that were (1) intact, (2) ovariectomized, (3) intact + estrogen, (4) ovariectomized + estrogen; (5) from primiparous cows, 100-250 d of gestation; (6) from lactating cows, 14 d lactation; (7) from cows during the dry period, 40 d dry and 20 d prepartum. Total RNA was extracted from three or four animals at each stage and pooled to determine patterns of miR expression by hybridization to a microarray containing modified RNA targets complementary to all known mirR. Expression of miR such as miR-221 and miR-127 appeared to be differentially expressed prepubertally. Expression of miR-615 was enhanced by estrogen treatment and miR-29a by ovariectomy. During first gestation, expression of miR-20a was increased. During lactation, miR were typically expressed at low levels, but there was increased expression of a limited number of miR, including miR-326 and miR-350. During the dry period, there was increased expression of miR-542-5p and miR-690. We subjected individual RNA samples to quantitative RT-PCR and confirmed patterns of expression revealed by microarray in 4 of 5 genes tested. Our quantitative RT-PCR results confirmed the utility of evaluating miR expression by microarray and suggested that miR function as regulators of mammary gland development and function.

Key Words: Regulatory RNA, Gene Expression, Lactation

539 Growth hormone stimulates growth hormone receptor expression through STAT5-activation of growth hormone receptor 1A promoter in the bovine liver. H. Jiang*, Y. Wang, M. Wu, and R. Torres-Diaz, *Virginia Polytechnic Institute and State University*, *Blacksburg*.

The objective of this study was to determine whether and how growth hormone (GH) regulates hepatic expression of GH receptor (GHR) mRNA and protein in cattle. Ribonuclease protection assays revealed that injection of recombinant bovine GH in a slow-release formula increased both hepatic GHR and insulin-like growth factor I (IGF-I) mRNAs one week after initiation of treatment. The increases in GHR and IGF-I mRNAs were highly correlated. Western blot analysis showed that the injection also increased GHR protein level in the liver. In cattle and several other mammals, hepatic GHR mRNA is expressed as variants that differ in the 5′-untranslated region, due to use of different promoters in transcription and/or alternative splicing. We found that GH injection increased the expression of the liver-specific GHR mRNA variant 1A (GHR1A), without affecting GHR1B and GHR1C mRNAs, the other two major GHR mRNA variants in the bovine liver. Transient transfection analyses of a 2.7 kb GHR1A promoter in reconstituted GH-responsive cells showed that GH could robustly activate reporter gene expression from this promoter, suggesting that GH augmentation of GHR1A mRNA expression in the liver is at least partially mediated at the transcriptional level. Further transfection analyses of serially 5′-truncated fragments of this GHR1A promoter narrowed the GH-responsive sequence element down to a 210 bp region that contained a putative signal transducer and activator of transcription 5 (STAT5) binding site. Electrophoretic mobility shift assays demonstrated that this putative STAT5 binding site was able to bind to STAT5b protein. In transfection assays, deletion of this putative STAT5 binding site abolished most of the GH response of the GHR1A promoter. These observations together suggest that GH stimulates the expression of one GHR mRNA variant, GHR1A, through binding STAT5 to its promoter, thereby increasing GHR protein expression in the bovine liver.

Key Words: Cattle, Growth Hormone Receptor, Liver

540 Temporal longissimus muscle gene expression profiles due to plane of dietary energy in early-weaned Angus steers. D. E. Graugnard*, S. L. Rodriguez-Zas, D. B. Faulkner, L. L. Berger, R. E. Everts, H. A. Lewin, and J. J. Loor, *University of Illinois*, *Urbana*.

Energy-dense nutrients might trigger long-term genomic adaptations of economic importance in skeletal muscle of young steer calves. Objectives were to evaluate temporal gene expression profiles in longissimus muscle (LM) of early-weaned (~140 d age) Angus steers (n = 6/diet) fed a high-grain (HiE, NE = 1.43 Mcal/kg) or high-byproduct (HiF, NE = 1.19 Mcal/kg) diet for 120 d, at which point all steers were switched to a common feedlot diet until slaughter. LM biopsies for transcript profiling and blood for metabolite analyses were collected at 0, 60, and 120 d of feeding. BW, ADG, back fat (d 60 and 120), and marbling scores (d 60 and 120) also were measured. A 13,257 bovine oligonucleotide (70-mers) array was used for transcript profiling. Annotation was based on similarity searches using BLASTN and TBLASTX against human, mouse, and bovine UniGene databases, the human genome, and the cattle TIGR database. Cy3- and Cy5-labelled cDNA from LM and a reference standard were used for hybridizations. Feeding HiE vs. HiF resulted in greater (time × diet $P < 0.05$) temporal blood glucose concentrations (88 vs. 80 mg/dL on d 120), whereas HiF increased (time × treatment $P = 0.06$) blood β-hydroxybutyrate (BHBA) concentration (0.48 vs. 0.36 mmol/L on d 120) to a greater extent than HiE. ADG over the 120 d tended ($P = 0.08$) to be greater with HiE (3.6 vs. 3.4 kg/d). ANOVA (FDR $P = 0.10$) identified 504, 67, and 141 differentially expressed genes due to time, diet, and diet × time, respectively. Genes associated with aspects of metabolism (e.g. protein or fatty acid synthesis), development, and signal transduction activity predominated among those affected by time × treatment. Results suggest that high plane of dietary energy during the early growth phase might improve efficiency of gain at least in part through the provision of a specific pattern of nutrients (e.g. glucose vs. BHBA) to skeletal muscle, which can in turn directly or indirectly promote genome-wide alterations in gene expression affecting tissue growth and development.

Key Words: Genomics, Growth, Energy

541 Creation of a gene atlas in cattle using sequence-based transcriptional profiling. T. S. Sonstegard*[1], J. W. Keele[2], G. P. Harhay[2], T. P. L. Smith[2], L. K. Matukumalli[1,3], G. Liu[1], C. P. Van Tassell[1], and L. J. Alexander[4], [1]*USDA, ARS, Beltsville Agricultural Research Center*, *Beltsville, MD*, [2]*USDA, ARS, U.S. Meat Animal Research Center*, *Clay Center, NE*, [3]*George Mason University*, *Fairfax, VA*, [4]*USDA, ARS, Livestock and Range Research Laboratory*, *Miles City, MT*.

Numerous opportunities to advance the understanding of how heritable variation affects economically important traits are being provided through resources generated from the Bovine Genome Sequencing project. Success in these investigations relies upon the depth in which the sequence assembly is annotated. In humans and biomedical model species, extensive annotation to identify genes and report relative levels of expression in various tissues has been accomplished by creation of Gene Atlas databases that provide researchers instant access to the expression profile of a gene under study. Similarly, we are constructing a Bovine Gene Atlas database that will house transcript profiles from 100 different bovine tissues collected from major organ systems. RNA was extracted using tissues derived from the genome sequencing cow and her offspring. Transcript profiles were captured using a digital, sequence-based approach known as Sequence-By-Synthesis from a Clonal Single Molecule Array. Yield of 20 bp cDNA sequence tags exceeded more than 5 million counts per sample. The more than 500 million tags were grouped according to tissue of origin, sequence similarity and genome map position in order to assign gene identities and account for potential sequencing errors. To test the correlation between the sequence tag data and a known pathway for synthesis of 3, 16 or 17-Glucuronide, tag counts for gene members of this pathway were compared between adult testes, two stages of uterus development, muscle, and placentome. Tag count analysis revealed this metabolic pathway is greater than 50 fold more active in ovary and uterus versus testes, placentome, and muscle. We conclude relative levels of expression for nearly all genes, even those for rare and species-specific transcripts, can be accurately determined. Such a framework of expression data will allow determination of regional transcriptional control, tissue phylogeny and interconnected gene networks. This Gene Atlas will be provided as a query-based resource to other researchers through a Web accessible database.

Key Words: Cattle, Gene Expression, Transcription

542 Effect of an enhanced-growth feeding program on gastrointestinal tract and spleen development. M. Terré*[1], M. Devant[1], A. Aris[1], and A. Bach[1,2], [1]*IRTA-Unitat de Remugants*, *Barcelona, Spain*, [2]*ICREA*, *Barcelona, Spain*.

Eighteen Holstein male calves (4.4 ± 1.85 d old) were arranged in 2 groups to study the effect of an enhanced-growth (EF) and conventional feeding program (CF) on gastrointestinal tract (GIT) and spleen development. Calves were fed a milk replacer (21% CP, 19.2% fat) at increasing rates during 4 d until reaching 4 l/d at 12.5% DM. Calves on CF received 4 l/d at 12.5% DM until weaning, and EF calves were fed 4 l/d at 15% DM from 5-11 d, 4 l/d at 18% DM from 12-18, 6 l/d at 18% DM from 19-38 d, and 3 l/d at 18% from 39-45 d. Calf starter was offered ad libitum until the end of the study (54 d). Individual calf starter consumption and BW were recorded. Half of the calves of each treatment were euthanized at 4 wk of study, and the rest at 54 d. Then, the spleen was dissected and weighed. Each anatomical part of the GIT was separated, weighed, emptied, weighed again, and pH of the contents of each GIT segment measured. Calves on EF grew faster ($P < 0.05$) than CF calves (0.82 vs 0.50 ± 0.089 kg/d, respectively). Starter intake was greater ($P < 0.05$) in CF than EF calves from 30 to 33 d, but lower ($P < 0.05$) from 48 to 54 d. Calves on CF had a greater ($P < 0.05$) rumen pH at 4-wk and 7-wk sacrifices (5.47 ± 0.056) and a lower abomasum pH ($P < 0.05$) at 4-wk sacrifice (3.01 ± 0.362) than EF calves (5.26 ± 0.056 and 5.04 ± 0.362, respectively). The spleen weight of EF calves was greater ($P < 0.05$) than that of CF calves (0.32 vs 0.24 ± 0.022 kg, respectively), but when expressed as a percentage of BW there were no differences between treatments. Abomasum weight expressed as a percentage of total GIT weight was greater ($P < 0.05$) in CF than in EF calves (11.0 vs 8.8 ± 0.54, respectively), but jejunum-ileum weight expressed as a percentage of GIT was greater ($P < 0.01$) in EF than in CF calves (50.4 vs 46.7 ± 0.98, respectively). Although EF calves grew faster, abomasum weight decreased and jejunum-ileum weight increased as a percentage of GIT when raising calves on an enhanced-growth feeding program.

Key Words: Calves, Enhanced-Growth, Gastrointestinal Tract

Animal Behavior & Well-Being - Livestock and Poultry: New Methodologies Symposium

543 Utilizing neural network analysis in animal behavior studies. W. B. Roush*, *USDA-ARS Poultry Research Unit*, *Mississippi State, MS*.

The objective of this presentation is to introduce the concept of artificial neural networks (ANN) and the related technologies of fuzzy logic (FL) and genetic algorithms (GA) to the analysis of animal behavioral responses. These technologies have been developed in the areas of Artificial Intelligence and Artificial Life for the study of Complex Systems. ANN were inspired by the biological neuron with inputs, a processing unit, and output(s). The concept for ANN is very similar to the concept of regression analysis. A fundamental difference is that regression analysis is philosophically linear; whereas, ANN are nonlinear. Most biological responses are nonlinear in nature and therefore a nonlinear analytical technique like ANN can more accurately and precisely be used to analyze the data. An example is the analysis of the effect of stressors (e.g., debeaking, coccidiosis, electrical shock, ammonia, heat stress, and noise) on the live gain response of birds. FL and GA are related computer techniques that can be used for analysis and optimization. FL can represent imprecise concepts such as hot, cold, heavy, light, comfort, and stress. The technique has been applied to the problem of defining stress of caged laying hens based on a FL representation of mortality, corticosterone level and egg production. Fuzzy Cognitive Maps (FCM), based on the principles of FL, can be used to define social conditions as defined by interactive matrices. An example is the structuring of a virtual world involving the interaction between sharks, fish and dolphins. GA optimize by evolving the inputs of a formula (e.g. ANN) into an optimal solution. Artificial intelligence and Artificial Life techniques such as ANN, FL and GA promise to provide powerful tools for the analysis of animal behavior studies.

Key Words: Behavior, Artificial Neural Network, Fuzzy Logic

544 Identification of QTL affecting disposition in *Bos indicus* influenced cattle. C. A. Gill*, C. R. Boldt, C. A. Abbey, M. A. Wegenhoft, D. K. Lunt, J. E. Sawyer, A. D. Herring, and J. O. Sanders, *Texas A&M University*, *College Station*.

Disposition was measured in 2 resource populations: 614 progeny from 40 *Bos indicus* (Brahman or Nellore) x Angus reciprocal backcross families and 3 F_2 families (Angleton herd); and, 465 progeny from 17 Nellore x Angus F_2 families and paternal half-sib families produced by natural service (McGregor herd). In the Angleton study, disposition scores were taken twice (weaning and slaughter) using a 1 to 5 scale. In the McGregor study, overall disposition and 4 component traits of behavior (aggressiveness, nervousness, flightiness, and gregarious) were measured 1 mo after weaning by a panel of 4 evaluators using a 1 to 9 scale. Steer progeny were scored again about 1 wk prior to slaughter by a single evaluator and overall disposition was scored prior to slaughter. The MIXED procedure of SAS was used to analyze disposition with fixed factors of sire, family nested within sire, birth year-season combination and sex x family within sire interaction, plus sequence within pen within birth year-season combination for the McGregor study. Mendelian and partially imprinted QTL for overall disposition were detected following interval mapping by linear regression under a line-cross model using residuals from the Angleton study. Three QTL on BTA 5, 17 and 25 affecting disposition at weaning and 2 QTL on BTA 1 and 18 affecting disposition prior to slaughter were estimated to have additive effects. Three QTL on BTA 4, 9 and 25 affecting disposition prior to slaughter were estimated to have dominance effects. A QTL affecting disposition at weaning on BTA13 was estimated to be partially maternally imprinted, while a QTL on BTA8 affecting disposition prior to slaughter was estimated to be partially paternally imprinted, and a QTL on BTA16 was estimated to be partially maternally imprinted. Only the QTL on BTA25 appeared to affect both weaning and final disposition. We have begun to characterize candidate genes for these QTL. We expect to validate these QTL in the McGregor study and to identify QTL for the 4 component traits of behavior.

Key Words: Disposition, Bovine, QTL

545 Mathematical modeling and analysis of use of space. M. C. Christman*[1], C. P. Miller[1], and I. Estevez[2], [1]*University of Florida*, *Gainesville*, [2]*University of Maryland*, *College Park*.

Spatial confinement imposes behavioral restrictions on animals because of limitations in movement and use of space. Such limitations are particularly exacerbated in farm animals that are maintained in intensive commercial production systems. Despite the important consequences of space availability/quality on the health and welfare of farm animals, many existing studies do not include study of patterns of movements because of the lack of adequate statistical methods for descriptors for movement and behavior in confined space. We describe a complex computer simulation of individual-based movement in confined space and its application. Our objective is to obtain a process model simulating animal movement and behavior that can be used to study statistical methodology as it relates to testing hypotheses about the effects of varying density and available area for confined animals. Our animal model is the domestic fowl Gallus gallus domesticus although the model can be used with other species that are found in limited or confined habitat. We simulate movement as a correlated random walk with additional controls to allow for the ability to manipulate the reaction of the animal to boundaries, the tortuosity of its steps, and the degree to which it avoids areas already visited. In addition, the model can be modified to allow for behavior that changes through time such as might occur with age and to incorporate behavior in response to new resources or to other animals within its space. Using this model, we have developed new descriptors of movement and use of space in confined regions. For example, we have developed new measures of tortuosity and core areas that are useful for distinguishing among the effects of varying environments. The model can also be used to do power analyses in order to determine adequate sample sizes and sampling regimes such as the interval between observations of a focal animal. We demonstrate use of these new methods using data from an experiment on domesticated fowl in which density and pen size was varied and show that our new methods are better than those originally developed for animal studies in unconfined space.

Key Words: Correlated Random Walk, Behavior, Domestic Fowl

546 Major pitfalls in animal welfare research. J. J. McGlone*[1], L. E. Hulbert[1], N. Krebs[1], M. A. Sutherland[1], and J. W. Dailey[2], [1]*Texas Tech University*, *Lubbock*, [2]*USDA Livestock Issues Research Unit*, *Lubbock, TX*.

Animal welfare researchers are obligated to provide the best quality of research possible to meet scientific standards and society concerns. The conclusions derived from studies can have major consequences on animals and the animal industries. However, major pitfalls are far too common in animal welfare research. The following potential problems (not in priority order) associated with these specialized types of investigations include: 1) Lack of statistical replication/duplication within studies, lack of simultaneous inter-institution replication and related ethical considerations of inappropriate sample sizes, 2) Lack of a defined biological or applicable control, 3) Lack of including both physiology and behavior data collected in a study, which then requires an entire new study to gather the missing information, 4) Lack of collaboration between research competitors, some of which have special skills, 5) Ambiguity, inaccuracy, lack of precisions and insufficient depth of behavioral and physiological measures, 6) A reliance solely on incomplete electronic data bases and inattention to early, valuable work that is relevant or directly answers the question at hand, 7) Inconsistent behavioral definitions, setting up a difficulty in comparing and interpreting research. 8) An inability to understand the meaning of changes in behavior or physiology (sometimes simply due to this neonatal science), 9) Lack of agreement on appropriate measures/standards of animal welfare, 10) Inappropriate anthropomorphism. While it is important that scientists have empathy and show compassion for animals, the necessary leap from human perception to animal perception should be executed with caution and discretion. All of these tribulations could result in flawed conclusions, which could have detrimental effects on regulations and actual animal welfare.

Key Words: Animal Welfare, Methods, Behavior

Animal Health - Livestock and Poultry: Bovine II

547 New frontier in monitoring, early diagnostics and prevention of ketosis in dairy cows. K. L. Ingvartsen*, N. C. Friggens, and T. Larsen, *University of Aarhus, Faculty of Agricultural Sciences*, *Tjele, Denmark*.

The objective of this presentation is to give a status on the opportunities for prevention of e.g. ketosis in dairy cows using future monitoring systems. Although the incidence of clinical ketosis is generally low, sub-clinical ketosis is important as it occurs more frequently. It may increase the risk of other diseases, involuntary culling and impair production and reproduction. The large between-cow variation in e.g. β-hydroxybutyrate (BHBA), calls for proactive prevention of ketosis by identifying and changing e.g. nutrients to 'high risk cows'. Such cows may be in imbalance - situations where the regulatory mechanisms are insufficient for the animals to function optimally leading to a high risk of disease. We have developed a model for the prediction of the risk of ketosis in dairy cows using in-line measurements of BHBA in milk (Nielsen et al., JDS 88, 2441-2453). The model is designed to function solely on the basis of milk BHBA but other data can be included as additional risk factors for ketosis. Outputs of the model are the risk of ketosis (value between 0 and 1, where 0 = no risk and 1 = full blown ketosis) and how many days until the next milk sample should be taken and analyzed for BHBA. Prototype sampling systems for in-line measurement of e.g. BHBA in milk that utilize the above model have been developed. Such systems open up for 'Status oriented strategies based on risk management' that allow, on farm and at individual cow level, adjustment of feeding and management based on automatically registered indicators to reduce the risk of diseases but at the same time improve production and reproduction (Ingvartsen 2006, Anim. Feed Sci. Tech. 126: 175-213). A challenge in building such strategies is to better understand the biological basis of the imbalance measured and thus to be able to predict individual animal responses to changes in e.g. nutrient supply or management to overcome the imbalance. Progress towards a better understanding will come through a combination of classical physiology, metabolic network mapping (e.g. proteomics) and quantitative modeling.

Key Words: In-line Monitoring, Ketosis, Disease Prevention

548 *Neotyphodium coenophialum* alters blood metabolites involved in nitrogen, energy, and mineral metabolism in growing steers. K. R. Brown*[1], L. R. Harrison[2], J. L. Klotz[3], J. R. Strickland[3], J. A. Boling[1], and J. C. Matthews[1], [1]*Department of Animal and Food Sciences*, *Lexington, KY*, [2]*Livestock Disease Diagnostic Center*, *Lexington, KY*, [3]*Forage-Animal Production Research Unit, USDA-ARS, University of Kentucky*, *Lexington, KY*.

Blood metabolite changes in steers during summer-long grazing of toxic endophyte-infected pastures were investigated as a part of a larger study for determination of physiological genomic and metabolic pathways for alkaloid metabolism. Blood cell counts, differentials, and serum metabolites of growing steers grazing fescue infected either with high (HE) or low (LE) amounts of toxic endophyte for 85 d were determined. Experimental treatments consisted of steers grazing either a LE (6.8% infection) mixed grass-tall fescue pasture (n = 9; BW = 266 ± 10.9 kg; 5.7 ha) or a HE (62.8% infection) tall fescue pasture (n = 10; BW = 267 ± 14.5 kg; 5.7 ha). Blood samples were collected by jugular venipuncture on d 0, 36, 57, and 85 of the study. Values presented are those for which no treatment × day of trial interaction was observed. Steers grazing HE pastures had decreased serum alanine transferase ($P < 0.02$, 10.2%), aspartate aminotransferase ($P < 0.04$, 9.9%), albumin ($P < 0.01$, 4.3%), and albumin:globulin ($P < 0.05$, 6.4%). No changes were observed for γ-glutamyl transferase, blood urea nitrogen, creatitine, total protein, globulin, or total bilirubin compared to the LE steers. Lactate dehydrogenase ($P < 0.01$, 13.4%) and glucose ($P < 0.05$, 6.3%) were lower in the HE steers. Serum concentrations of magnesium, sodium, and chloride did not differ, but phosphorus was lower ($P < 0.02$, 5.9%) in steers grazing the HE pasture compared to LE. No differences were observed in packed cell volume, red blood cells, hemoglobin, white blood cells, segments, lymphocytes, monocytes, and eosinophils between the two treatments. This study suggests chronic exposure to toxic endophyte-infected tall fescue selectively decreased blood components that are important indices for growth and metabolic function.

Key Words: Endophyte, Fescue, Metabolite

549 Changes in lying behavior of lactating dairy cows associated with body condition score and milk yield. J. M. Bewley*[1], R. E. Boyce[2], L. Munksgaard[3], C. Drummond[4], J. Hockin[4], B. Scott[4], and M. M. Schutz[1], [1]*Purdue University*, *West Lafayette, IN*, [2]*IceRobotics, Ltd.*, *Roslin, Scotland, UK*, [3]*Danish Institute of Agricultural Sciences*, *Research Centre Foulum, Denmark*, [4]*Barony College*, *Dumfries, Scotland, UK*.

The lying time (LT) of lactating Holstein-Friesian cows of varying body condition scores (BCS) and milk yield were measured using IceTag™ animal activity monitors in the Barony College dairy herd. A three-week average BCS was calculated for each cow and in total 84 cows were divided equally between 3 BCS categories (BCAT) [Thin(T): BCS <2.75; Moderate(M): 2.75≥BCS<3.25; Heavy(H): BCS≥3.25] and 2 stage of lactation categories (LCAT, < or > 150 days in milk). The cows were kept in two management systems (MS, parlor (n=24) or AMS, (n=60)). Behavior was recorded for 5-7 days for each cow. An average of October and November test day fat and protein corrected milk was calculated for each cow (FPCM). Cows that exhibited clinical lameness before or during the observation period were excluded. For cows exhibiting estrus, the day of and the day prior to breeding were removed. When LT, hours standing, or number of steps taken within an individual day differed from an individual cow's weekly average by 2 or more standard deviations, these observations were removed. The final analysis included 79 cows (433 observations). The effects of FPCM , BCAT, week, and day within week were included in a mixed model (p=0.0074, 0.1223, 0.0007, and 0.0070, respectively). Effects LCAT, MS, FPCM/BCAT interaction, and pregnancy status were not significant and not included in the model. Lying time decreased with increasing milk yield. The LSMeans for LT within BCS category were 10.96(±0.293), 10.43(±0.286), 10.10 (±0.288) for H, M, and T, respectively, with H and T significantly different (P=0.0412). Both BCS and milk yield affected the lying behavior of the cows. Thin cows may be challenged to meet generally recommended lying times of 10 hours per day, though specific lying times for different body conditions remain to be determined.

Key Words: Lying Behavior, Activity Monitor, Automatic Monitoring

550 Rectal versus peripheral temperature measurement using radio-frequency implants in steers challenged with lipopolysaccharide during periods of heat stress. E. D. Reid*[1], J. M. Velasco[1], and G. E. Dahl[2], [1]*University of Illinois*, *Urbana*, [2]*University of Florida*, *Gainesville*.

Heat stress in cattle reduces production and profit for livestock owners. Heat stress causes an increase in body temperature, which makes it difficult to identify sick animals in systems using rectal temperature as a tool to assess animal health. Injectable radio frequency implants (RFI) that can monitor temperature at the site of implantation are available and readings are positively correlated with rectal temperature (RT) during periods of heat stress. These RFI also exhibit a negative correlation with RT when cattle are challenged with lipopolysaccharide (LPS). We hypothesized that the RFIs, implanted under the scutiform cartilage of the ear of steers would be positively correlated to RT during controlled heat stress, and would exhibit a negative correlation to RT during a challenge with LPS during heat stress. To test this hypothesis, four steers (127 ± 7 kg) were moved into controlled environment chambers with individual stalls (2 steers per chamber), implanted with RFI, and allowed 2 wk to acclimate. One chamber remained at 20 C, the other was increased to 35 C starting at 0800 for a period of 48 hours. LPS was administered to all steers at 1000 on day 2. The steers were then given a 2 wk adjustment period at 20 C, and the temperature was increased in the opposite chamber, resulting in a crossover statistical design with each steer as its own ambient control. Rectal and RFI temperatures were logged at 5 min intervals. Ambient temperature was also recorded every 5 min and was included as a covariate in the statistical model. Pearson correlation coefficients for RFI and RT were 0.08 (P=0.44) during heat stress, 0.20 (P=0.05) during heat stress with LPS challenge, 0.41 (P<0.01) during the ambient period, and -0.42 (P<0.01) during the ambient period with LPS challenge. Individual response varied; some exhibited negative correlation while others exhibited positive correlation. These data do not support the hypothesis and suggest that individual response be considered when identifying models for use of RFI in temperature monitoring.

Key Words: RFID, Temperature, LPS

551 Hemodynamics in the caudal artery of yearling steers following removal from toxic tall fescue and placement on non-toxic diets. G. E. Aiken*[1] and L. K. McClanahan[2], [1]*USDA-ARS-FAPRU*, *Lexington, KY*, [2]*University of Kentucky*, *Lexington*.

Doppler ultrasonography was used to monitor changes in blood flow characteristics of the caudal artery in yearling steers after being removed from toxic 'Kentucky 31' fescue pastures and placed on non-toxic diets. Ergot alkaloids, produced by the *Neotyphodium* endophyte that infects tall fescue, bind α-adrenergic receptor sites that constrict peripheral vascular tissues and reduce the animal's ability to dissipate body heat. Forty steers were stratified by BW for assignment to five, 3.0-ha pastures. The steers were grazed for 112 d starting on 2 June, 2005. Upon termination of grazing on 12 September, thirty-six of the steers were randomized into groups of three for placed into small pens and fed a wet corn silage-concentrate mixture ad libitum. Ultrasound scans of the caudal artery at the 4th coccygeal vertebrae were taken using an Aloka 3500 Ultrasound Unit (Aloka, Inc., Wallingford, CT). Three cross-sectional scans were taken to determine mean artery lumen area, and three Doppler spectra with a longitudinal transducer orientation were collected to estimate mean velocity, heart rate, stroke volume, and flow rate. Ultrasound measures were collected at 0 (initial measures), 1, 7, and 71 days on non-toxic diets (DNTD). Temporal changes in ultrasound measures were analyzed with mixed models. Initial caudal artery area (5.4 mm^2) had increased ($P < 0.001$) by 7 DNTD (6.6 mm^2) and further increased ($P < 0.001$) by 71 DNTD (7.2 mm^2). Heart rate was initially low (111 beats/min), but increased ($P < 0.01$) to 124 beats/min by 7 DNTD. Heart rates were similar ($P > 0.10$) between 7 and 71 DNTD. Stroke volume tended ($P < 0.10$) to increase between 0 (0.40 mL) and 7 (0.5 mL) DNTD, but had substantially increased ($P < 0.001$) from the initial volume by 71 DNTD (0.58 mL). Initial flow rate (38.3 mL/min) increased ($P < 0.05$) by 7 DNTD (47.5 mL/min) and further increased ($P < 0.001$) by 71 DNTD (61.8 mL/min). Results indicated that vasoconstriction can be reduced, but not eliminated, in 7 d after cattle are removed from toxic fescue and placed on non-toxic diets.

Key Words: Tall Fescue, Ergot Alkaloids, Vasoconstriction

552 Response of digital dermatitis to treatment with topical lincomycin or oxytetracycline: comparison of gross visual and histopathological observations one month after treatment. B. Nuccitelli[1], S. L. Berry*[1], D. H. Read[2], R. L. Walker[2], and T. R. Famula[1], [1]*University of California*, *Davis*, [2]*California Animal Health and Food Safety Laboratory*, *Davis, CA*.

Cows were enrolled in the study if they had active digital dermatitis (DD) on one or both rear feet. Twenty-five cows were allotted to 3 groups: 1) treated with 10 g lincomycin HCl (n=11), 2) treated with oxytetracycline HCl (n=11), or 3) no treatment (n=3). Cows were restrained on a tilt-table; lesions were photographed and 6 mm punch biopsies were taken and placed in formalin to be examined for histopathology. For treated cows, lincomycin HCl or oxytetracycline HCl was mixed with sufficient deionized water to make a paste, applied to a 4X4 gauze, placed on the lesion, and held in place with a light bandage. Control cows were bandaged after biopsy but received no topical antimicrobial. Lesions were re-photographed at approximately days 14 and 30. At the d 30 examination, biopsies were taken adjacent to the site of the first biopsy and submitted for histopathology. The pathologist (DHR) had no knowledge of treatment groups when he examined the samples submitted. Based on gross examination at d 14, 20/22 of the treated lesions appeared to be healed (improved lesion score, no pain, and no visible activity). Based on gross examination at d 30, 18/22 treated lesions appeared to be healed and 4/22 lesions appeared to be active. Two of the 3 lesions on control cows appeared active and were painful; the 3rd lesion appeared to be healing. Of the 18 lesions that appeared to be healed, 10/18 (55%) were classified histologically as active or incipient. Histologic evaluation of activity of DD lesions was based on the degree to which there was: 1) loss of the epidermal barrier, 2) invasion of the stratum spinosum and 3) invasion of the papillary dermis by profuse numbers of slender, spiral organisms. Histological examination agreed with gross visual examination prior to treatment with antimicrobials but did not agree 1 month after the lesions were treated. We could not distinguish between recurrent lesions or new infections.

Key Words: Digital Dermatitis, Footwarts, Lameness

553 Mechanical properties of the solear hoof horn of heifers before and during the first lactation as a prediction of lameness susceptibility. B. Winkler[1], J. K. Margerison*[2], and C. S. Brennan[2], [1]*University of Plymouth*, *Plymouth, UK*, [2]*Massey University*, *Palmerston North, New Zealand*.

Mechanical tests were completed on samples of sole hoof horn taken from 20 heifers at 2 months before parturition (p1) and 100 days postpartum (p2). Simultaneously, all claws were assessed for the lesions score (LS) in the sole horn. Heifers were kept at pasture prepartum and housed loose in a straw bedded yard postpartum. Hoof samples were collected from all claws and analysed for elastic modulus (ELM) and puncture resistance (PR), each measurement was replicated five times on the same area of each claw. Data was analysed by ANOVA GLM using period and claw as fixed effects. PR force of the sole horn was significantly greater in front claws (FC) when compared to hind claws (HC) ($P<0.05$) (p1- FC 8.2, HC 7.4N, p2- FC 11.1, HC 10.3N). The PR force and ELM significantly increased postpartum compared with prepartum ($P<0.01$) (p1- 7.8, p2- 10.7N and p1- 86.9, p2- 118.0N/mm2), while the LS of the claw horn increased between periods ($P<0.001$) (p1- 73.1, p2- 186.5). No significant difference in LS was found between FC and HC in the prepartum period, however LS was significantly greater in the HC compared with the FC in the postpartum period ($P<0.001$) (HC 223.7, FC149.3). Prepartum ELM and PR force were not correlated with lesion score either pre or postpartum. However, postpartum ELM and PR force were significantly negatively correlated ($P<0.01$) to the increase in lesion score between periods ($R=0.65$). Mechanical tests reflected the changes in housing and in haemorrhage levels that occurred between p1 and p2.

Key Words: Lameness, Dairy, Hoof Tissue

554 Effect of sample thickness, tissue moisture content and storage methods on the punch resistance and elastic modulus of the bovine hoof horn. B. Winkler[1] and J. K. Margerison*[2], [1]*University of Plymouth*, *Plymouth, UK*, [2]*Massey University*, *Palmerston North, New Zealand*.

Tissue sample treatment and storage was assessed using hooves of six beef cattle (24 and 28 months) from an abattoir. Tissue samples from the sole and white line of each claw (5 and 2 of International Foot Map) and kept in sealed plastic bags at room temperature until conditioning from physiological moisture content (0) and relative humidity (RH) 11, 33, 58, 75 and 97%; sample thickness (0.05 and 0.3 mm); storage duration in plastic bags 2°C for 0, 48, 96, 144 and 192 hours and freezing (-20°C) for 7, 14 and 28 days. After treatment tissue samples were tested 12 times for punch resistance (PR) and elastic modulus (EM) using a Texture Analyser. Samples were tested for DM content. Increase in DM resulted in a significant ($P<0.01$) linear increase in the PR (N) of the sole (PR= 0.490; DM: 24.39, Rsq.= 0.54) and the white line horn (PR= 0.430; DM: 24.87, Rsq.= 0.64). The EM (N/mm2) of the sole horn was significantly ($P<0.01$) positively exponentially related to the DM (EM= 0.0602e0.1012x, Rsq.= 0.81). DM varied from 63.7 to 89.1%, PR of the sole horn from 6.24 to 24.66N, PR of the white line horn from 2.17 to 18.60N and EM from 85.5 to 751.9N/mm2. The days (1 to 8) taken to analyse the samples and freezing for up to 28 days had no significant effect on the DM and PR of the sole and white line horn. There was a significant ($P<0.01$) increase in the EM of the sole horn when samples were frozen for 28 days. PR increased in a positive significant ($P<0.001$) linear in relation to the thickness (mm) of the area tested (PR= 6.679 + 34.531 thickness, Rsq.= 0.66).

Key Words: Hoof, Beef Cattle, New Methods

Breeding and Genetics - Livestock and Poultry: Dairy Cattle II

555 Performance and physical conformation of first parity backcross Holstein x Jersey cattle and their Holstein contemporaries. K. A. Weigel*, T. J. Halbach, C. Maltecca, and P. C. Hoffman, *University of Wisconsin*, *Madison*.

The experimental population for the present study consisted of 194 backcross females, which were the offspring of 7 young Jersey x Holstein sires and 167 lactating Holstein dams, as well as 90 pure Holstein females, which were the offspring of 57 young Holstein sires and 83 lactating Holstein dams. These animals were born from November 2003 to January 2007 at the University of Wisconsin - Madison Integrated Dairy Facility. All first parity crossbred cows (N=40) and Holstein cows (N=23) were classified for linear type traits by a trained evaluator between 50 and 200 d postpartum. A linear model, which included fixed effects of classifier, days in milk, and pen, indicated that crossbred cows had shorter stature ($P<0.0001$), more strength ($P<0.05$), lower dairy form score ($P<0.10$), more slope from hooks to pins ($P<0.01$), narrower rump ($P<0.0001$), steeper foot angle ($P<0.01$), closer front teat placement ($P<0.10$), and straighter rear legs when viewed from the rear ($P<0.05$). Mean differences in body depth, rear legs when viewed from the side, fore udder, rear udder height, rear udder width, udder cleft, udder depth, teat length, and udder tilt were not significant. Crossbred cows were 35 kg lighter ($P<0.10$) at first calving, however, mean birth weight of their calves did not differ. Likewise, mean body condition score at first calving did not differ, nor did mean body condition score at breeding. Peak milk yield of crossbred cows was 4 kg lower ($P<0.05$), although fat and protein percentage did not differ. Based on these data, it appears that crossbreeding may improve mobility traits and reduce maintenance feed costs (through decreased body size), albeit at the expense of milk production.

Key Words: Dairy, Crossbreeding, Type

556 Crossbreds of Jersey/Holstein compared to pure Holsteins for production, fertility, and udder traits during first lactation. B. J. Heins, L. B. Hansen, A. J. Seykora, A. R. Hazel*, J. G. Linn, and D. G. Johnson, *University of Minnesota*, *St. Paul*.

Jersey/Holstein crossbreds (n = 76) were compared to pure Holsteins (n = 73) for 305-d milk, fat, and protein production, days open, number calving a second time, and udder traits during first lactation. Cows were housed at two University of Minnesota research facilities and calved from September 2003 to May 2005. Jersey/Holstein crossbreds were bred to Montbeliarde sires, and Holstein cows were bred to Holstein sires. Best Prediction was used to calculate actual production (milk, fat, and protein) for 305-d lactations. Adjustment was made for age at calving and herd-year and records less than 305 d were projected to 305 d. Jersey/Holstein crossbreds (249 kg) and pure Holsteins (251 kg) were not significantly different for fat production, but pure Holsteins had significantly higher milk (7179 kg vs. 6600 kg) and protein (224 kg vs. 209 kg) production than Jersey/Holstein crossbreds. Least squares means for days open were 136 for Jersey/Holstein crossbreds and 159 for pure Holsteins. Jersey/Holstein crossbreds had a higher percentage of cows that calved a second time than pure Holsteins, (87% vs. 77%) respectively. Udder clearance, front teat placement, and teat length were measured during first lactation. Udder clearance was measured from the ground to the bottom of the udder and front teat placement was the distance between the front teats. Age at calving, herd-year, stage of lactation, breed, and random effect of sire within breed were included in the statistical model. Jersey/Holstein crossbreds had significantly less udder clearance than pure Holsteins, (47.2 cm vs. 54.6 cm) respectively. Jersey/Holstein crossbreds and pure Holsteins were not significantly different for front teat placement (15.3 cm vs. 13.7 cm) and teat length (4.5 cm vs. 4.4 cm), respectively.

Key Words: Crossbreeding, Heterosis, Production

557 SNPs in the 3'UTR of Stearoyl-CoA desaturase gene in Canadian Holsteins and Jerseys. P. M. Kgwatalala, E. M. Ibeagha-Awemu*, J. F. Hayes, and X. Xhao, *McGill University*, *Ste Anne De Bellevue, Quebec, Canada*.

Stearoyl-CoA desaturase (SCD) catalyzes the synthesis of conjugated linoleic acid (CLA) and monounsaturated fatty acids (MUFA) in the mammary gland. A two to three-fold variation in CLA and desaturase index have been reported among animals on the same diet. We hypothesized that SNPs in the 3´UTR of the SCD gene result in different 3'UTR regulatory variants which influence the production of SCD enzyme and consequently its activity in the mammary gland, which may explain some observed variations in CLA and MUFA

content of milk fat between Holsteins and Jerseys and within these breeds. The main objective of our study was therefore to determine the existence of SNPs in the 3'UTR of the SCD gene in Canadian Holsteins and Jerseys. Genomic DNA from 46 randomly selected Holsteins and 35 randomly selected Jerseys was used for selective amplification and direct sequencing of the 3'UTR of the SCD gene. A total of fifteen SNPs (G1571T, G1644C, C1763A, T2053C, A2584G, T2668C, A3007G, C3107T, G3208A, T3290C, G3497A, G3682A, A4399T, C4533T and G4881A) were uncovered in the 3'UTR of the SCD gene. The SNPs linked together resulting in 3 regulatory variants in Holsteins: H1 (G1571G1644C1763C2053 A2584 C2668 A3007 C3107 G3208T3290 G3497 G3682A4399C4533G4881), H2 (G1571G1644A1763 C2053 A2584 C2668 G3007 C3107 G3208T3290 G3497 G3682 A4399 C4533G4881) and H3 (T1571C1644A1763T2053 G2584 C2668 G3007 T3107 A3208 C3290 A3497A3682 T4399T4533A4881) and only H1 and H3 variants in Jerseys. The H1 regulatory variant was the most prevalent in both breeds suggesting it may be the wild regulatory variant at the SCD locus, followed by the H3 variant. The search for functional motifs in the 3´UTR region of the SCD gene revealed the presence of internal ribosome entry site (IRES) motif in the H1 regulatory variant and its total absence in the other two regulatory variants. SNPs in the 3'UTR of the SCD gene may thus contribute to existing variations in CLA and MUFA content of milk fat between and within Holsteins and Jerseys.

Key Words: Singl Nucleotide Polymorphisms, SCD Gene, Regulatory Variants

558 Estimation of yields for long lactations using best prediction. J. B. Cole*[1], P. M. VanRaden[1], and C. M. B. Dematawewa[2], [1]*Animal Improvement Programs Laboratory, USDA*, *Beltsville, MD*, [2]*Virginia Polytechnic Institution and State University*, *Blacksburg*.

Lactation records of any length now can be processed with the selection index methods known as best prediction. Previous programs were limited to the 305-day standard used since 1935. Best prediction (BP) was implemented in 1998 to calculate lactation records in USDA genetic evaluations, replacing the test interval method used since 1969 to calculate lactation records of any length at dairy record processing centers. Best prediction is more complex but also more accurate, particularly when testing is less frequent. Programs were reorganized to output better graphics, give users simpler access to options, and provide additional output, such as BP of daily yields. Simple diagnostic plots are now available for milk, fat and protein yields and somatic cell score, and BP of individual daily yields, test day yields, and herd lactation curves can be obtained by the user for production of publication-quality figures. Test-day data for Holstein cows were extracted from the national dairy database, including lactations longer than 305 d. Records from first through fifth parities were included if lactation lengths were at least 250 d, records were made in a single herd, at least five tests were reported, and only twice-daily milking was reported. After edits, 171,970 first- and 176,153 later-parity records were available. Lactation lengths averaged 362 d in first and 369 d in later parities. 23.9% of first and 27.5% of later parities were longer than 305 d, and 3.3% and 3.4%, respectively, were longer than 500 d. Average yields at any day in milk were estimated using a 4-parameter exponential function. Correlations among test day yields were estimated using an autoregressive matrix to account for biological changes and an identity matrix to model daily measurement error. Autoregressive parameters (r) were estimated separately for first- (r=0.998) and later-parity (r=0.995) cows. These r were slightly larger than previous estimates due to the inclusion of the identity matrix, which accounts for test day variation. Many cows can produce profitably for >305 days in milk, and the revised program provides a flexible tool to model these records.

Key Words: Best Prediction, Milk Yield, Long Lactations

559 Genetic parameter estimates for days open by using a random regression model to analyze data from a long-term designed selection experiment. G. A. Gutierrez*, M. H. Healey, and P. J. Berger, *Iowa State University*, *Ames*.

The objective of this study was to estimate genetic parameters for days open (DO) by using a covariance function(CF)-random regression model. Data were collected at the Ankeny dairy research farm at Iowa State University from 1986 to 2004. A total of 3830 records from Holstein cows (n=766) were used in the analysis. Data were restricted to less than 6 parities. All cows were required to have a first parity record, but all cows did not have an opportunity to have completed all parities. Data were analyzed using two models: 1) a repeatability animal model, fixed effects for line of sire selection (high or average PTA fat plus protein), year-season, parity, and linear-Legendre polynomial (LLP) for age at calving(Average=39, min=20, max=90, and SD=16 mo), random effects for animal and permanent environment; and 2) random regression model, fixed effects as defined above for model 1, random LLP coefficients for additive genetic and permanent environment effects. Analyses were implemented by using ASREML v1.1. The covariance matrix of random regression coefficients was used to define the CF for the additive genetic and permanent environmental (co)variances across the trajectory of age at calving from 20 to 90 mo. In model 1, estimated values of heritability and repeatability for DO were 0.08 and 0.09, respectively. In model 2, the additive genetic variance tended to increase with age at calving. Heritability estimates were 0.07,0.08,0.09,0.10,and 0.10, respectively, at 24, 36, 48, 60 and 72 mo. The genetic correlation between records at different ages was fixed at 0.99. The percentage of phenotypic variance explained by permanent environmental variance varied from 3 to 19% across the 5 fixed ages. Repeatability ranged from 0.17 to 0.29. Permanent environmental correlations were highly variable; $r_{(24,36)}$=0.88, $r_{(24,48)}$=0.06, $r_{(24,60)}$= -0.48, and $r_{(24,72)}$= -0.65. Implication of this research is that CF-random regression approach gives a better description of the full (co)variance structure for repeated measurements of DO across a trajectory of age at calving than the repeatability model.

Key Words: Days Open, Random Regression, Holstein

560 Construction and application of a bovine high-density SNP assay. C. P. Van Tassell*[1], L. K. Matukumalli[1,4], C. Taylor[5], T. P. L. Smith[3], T. S. Sonstegard[1], R. D. Schnabel[2], M. V. B. De Silva[1], G. R. Wiggans[1], G. Liu[1], S. Moore[6], and J. F. Taylor[2], [1]*USDA, ARS Beltsville Agricultural Research Center*, *Beltsville, MD*, [2]*University of Missouri*, *Columbia*, [3]*USDA, ARS, US Meat Animal Research Center*, *Clay Center, NE*, [4]*George Mason University*, *Fairfax, VA*, [5]*Illumina, Inc.*, *San Diego, CA*, [6]*University of Alberta*, *Edmonton, AB, Canada*.

Bovine genomics has entered a new era and has been transformed by the availability of the whole genome sequence data. An additional resource currently under development is a 60,000 single nucleotide polymorphism (SNP) array that will soon be made commercially available. Targeted content for this SNP array includes all chromosomes with even-coverage throughout the bovine genome. The SNP array will be used in several large-scale genotyping projects, with over 10,000 animals genotyped. Resulting genotypes for Angus, Brown Swiss, Holstein, and Jersey animals will be used to construct breed specific haplotype maps and develop genomic selection procedures to enhance the prediction of genetic merit via integration with predictions from the national cattle evaluation. To date, nearly 2.5 million putative SNP have been predicted and/or obtained from publicly available databases. Validation of these SNP by resequencing has resulted in a wide range of success rates (from <40% to ~90%) correlating to the source of the in silico derived SNP. To supplement coverage for the design of the proposed SNP assay, we have generated over 24 million short DNA sequence reads and have identified approximately 50,000 new putative SNP among these sequences. Validation of these SNPs is currently in progress. The final assay is expected to be available by mid-summer, 2007.

Key Words: Genome Selection, Single Nucleotide Polymorphism, Marker Assisted Selection

561 Estimation of genetic parameters with random regression models using test-day records beyond 305 days in milk. J. Bohmanova[1], F. Miglior*[2,3], and J. Jamrozik[1], [1]*University of Guelph*, *Guelph, ON, Canada*, [2]*Agriculture and Agri-Food Canada*, *Sherbrooke, QC, Canada*, [3]*Canadian Dairy Network*, *Guelph, ON, Canada*.

Effect of inclusion of test-day records recorded after 305 days in milk on variance components estimates was investigated. Currently, only test-day records measured ≤305d are utilized in the Canadian genetic evaluation. Since increasing number of cows has longer lactation than 305d, it is of interest to also include test-day records measured after this cut-off point. However, such a change requires re-estimation of variance components. Two data sets were sampled from the Canadian national database. Data were test-day yields of milk, fat and protein and somatic cell score from the first three lactations of Canadian Holsteins recorded from 1988 to 2006. The first data set consisted of 96,756 test-day records of 6235 cows, with days in milk from 5 to 365d. The second data set was a subset of the first one and comprised 89,429 records with days in milk ≤305d. The pedigree file contained 18,178 animals. A multi-trait multi-lactation random regression model (RRM) with fixed effects of herd x test-date and fixed regression on days in milk nested within age x season class was implemented. Legendre polynomials were used to model fixed and random regression for additive genetic and permanent environmental effect. Heterogeneous residual variance was modeled with a step function with four intervals. Variance components were estimated using Bayesian procedures via Gibbs sampling. Posterior means of the parameters were estimated using 90,000 samples after 10,000 burn-in iterations. The problem of overestimation of variances at the edges of lactation connected to use of RRM with Legendre polynomial was observed with both datasets. However, with the first dataset (containing later test-day records) the increase in estimates occurred at larger days in milk and estimates of additive genetic variance of milk yield at 305d were by 1, 4 and 7 kg^2 lower. Adoption of RRM with later test-days can provide better prediction of 305d breeding values due to utilization of more data and better genetic parameters. Confirmation of predictive ability of RRM with the new parameters is in progress.

Key Words: Random Regression, Test Day Model, Variance Component

562 Selection of dairy cow families for superior pregnancy rate. C. N. Vierhout*, S. P. Washburn, R. L. McCraw, E. J. Eisen, and J. P. Cassady, *North Carolina State University*, *Raleigh*.

The objective of this study was to determine if dairy cow families could be used to select for superior pregnancy rate. Holstein cow records in 13 southern states were obtained from Dairy Records Management Systems. Cows were included from historical records dating back to birth year of 1981 or 1982 as the foundation cows. Historical records included cows calving and completing lactations through August, 2005. Cows from various generations were then put in maternal family groups using dam identification within herd. Milk production and calculated pregnancy rate (based on days open) deviations were obtained within herd-year-season. A family value was calculated by averaging the first and second lactations across parity by degree of relationship to the individual (free of progeny information) for generation one though four. Each family entered into one of four quartiles based on average deviations milk production and one of four quartiles for average deviations in pregnancy rate. Analysis was performed on fifth generation members to determine if milk production and pregnancy rates in the fifth generation were significantly associated with historical performance of the respective cow families. Average of the standardized values for milk production has improved (-0.09 to -0.01) from generation one to five while pregnancy rate decreased from (0.17 to 0.05) in the same period for cow families having daughters represented in the fifth generation. After adjustments for sire predicted transmitting ability (PTA), maternal-grandsire PTA, and family quartile for milk or pregnancy rate in the model the effect of maternal cow family remained highly significant for pregnancy rate ($P<0.0001$, $R^2=0.0147$) and milk production ($P<0.0001$, $R^2=0.010$). Thus, there may be potential economic value in considering maternal family history for pregnancy rate when selecting future bull dams.

Key Words: Pregnancy Rate, Days Open, Female Fertility

563 Mapping of quantitative trait loci economic important traits in Canadian holstein bulls. D. Kolbehdari*, S. Moore, and Z. Wang, *University of Alberta*, *Edmonton, Alberta, Canada*.

A whole genome scan for mapping quantitative trait loci (QTL) for economic important traits was performed in this study. Fifteen hundred and thirty-six bovine single nucleotide polymorphisms (SNPs) were selected to design the genotyping assay. The SNPs were distributed throughout the genome based on bovine genome assembly (Btau_2.1) and design at the Bovine Genomic lab of the University of Alberta. A total of 462 Canadian Holstein bulls with general pedigree, 319 originating from 10 core sire families, were genotyped using the designed assay. Among these SNPs, 139 were not amplified well during the genotyping, and therefore were removed from the linkage analysis. The SNPs physical position and the orders were recomputed based on the updated 7.1 X Bovine Genome Assembly (Btau_3.1). The

average polymorphism information content of the SNPs was 0.287 (0 to 0.375). The average SNP heterozygosity was 0.329 (0 to 0.50). Initial linkage analysis using variance component approach for milk, fat and protein yield has detected QTL at regions of the chromosomes known to harbor QTL based on previous studies. It is anticipated that this study will validate some of the QTL already mapped and new QTL will be discovered.

Key Words: Mapping QTL, Linkage Analysis, Dairy Cattle

564 Economic value of a marginal increase in pregnancy rate in dairy cattle. A. De Vries*, *University of Florida*, *Gainesville*.

Objective of this study was to estimate the economic value of a marginal (1-percentage point) increase in 21-d pregnancy rate in dairy cattle. The computer simulation program DairyVIP (http://dairy.ifas.ufl.edu/tools) was used. Based on user-defined inputs such as lactation curves, 21-d service rates, probabilities of conception, feed intake, involuntary culling, body weights, and costs and prices, DairyVIP first optimizes breeding and replacement decisions for individual dairy cows and then calculates many herd statistics such as pregnancy rate and profit per slot per year. An average herd in the US was modeled. Key default values were: service rate 43%, probability of conception 40% and slightly decreasing by DIM, heifer price $1600, and milk price $31/cwt. Default pregnancy rate was 16% and profit per slot per year was $389. Service rates and probabilities of conception were changed simultaneously and similarly. The economic values of a 1-percentage point increase in pregnancy rate around 7%, 14%, 18%, 23% and 34% were $32.04, $14.49, $9.92, $6.76, and $3.31 per slot per year, respectively. The greatest contributing factors were reductions in herd turnover costs resulting from lower cull rates. Sensitivity analysis by changing the default heifer price, milk price, milk yield, and risk of involuntary culling independently by 20% revealed that heifer price had the most effect on the economic value of a marginal increase in pregnancy rates. When heifer price was $1920, economic values were respectively $41.93, $17.89, $11.84, $7.98, and $3.73. When heifer price was $1280, economic values were respectively $21.71, $10.59, $7.44, $5.27, and $2.72. Twenty percent lower risk of involuntary culling and less time to become pregnant before culling also increased the economic value of marginal increases in pregnancy rates, but typically not more than $2. Greater milk price and greater milk yield increased the marginal value only when pregnancy rate was greater than 14%. In conclusion, the economic value of a marginal increase in 21-d pregnancy rate is considerably greater at lower levels of pregnancy rates.

Key Words: Pregnancy Rate, Economics, Value

565 Relationships between locomotion and lesion score, punch resistance and Holstein (HUKI) conformation scores. B. Winkler[1] and J. K. Margerison*[2], [1]*University of Plymouth*, *Plymouth, UK*, [2]*Massey University*, *Palmerston North, New Zealand*.

Dairy heifers (n 20) were used to assess locomotion, lesions score (LS) in the sole horn and hoof samples were collected from all claws and analyzed for elastic modulus (ELM) and puncture resistance (PR), each measurement was replicated five times on the same area of each claw. All heifers were assessed (HUKI) for conformation. Elastic modulus of the tension test of the sole at day 100 postpartum was significantly ($P<0.01$) negatively correlated to locomotion score at 154 dpp ($R2 = - 0.61$). HUKI score for rear legs was significantly ($P<0.05$) and positively correlated to punch resistance of sole and white line horn at 40 days prepartum ($R2 = 0.55$ and 0.50) and elastic modulus of sole at 50 dpp ($R2 = 0..53$). HUKI score for feet was significantly ($P<0.01$) and positively correlated to punch resistance and negatively correlated to lesion score of white line area at 40 days prepartum ($R2 = - 0.50$) and to the number of days the animals were severely lame throughout the lactation ($LS > 4$ ($R2 = - 0.50$)). HUKI locomotion score was significantly ($P<0.05$) and positively correlated to punch resistance of the white line horn at 100 dpp ($R2 = 0.50$). HUKI total score for legs and feet was significantly ($P<0.05$ to 0.01) negatively correlated to punch resistance of white line horn at 150 dpp ($R2 = - 0.50$) and the number of days the animals were severely lame throughout the lactation ($LS > 4$ ($R2 = - 0.48$)). HUKI total final score was significantly ($P<0.05$ to 0.01) negatively correlated to punch resistance of white line horn at 50 and 150 dpp ($r = - 0.50$) and to the punch resistance of the sole horn at 150 dpp ($R2 = - 0.60$).

Key Words: Conformation, Lameness, Dairy heifers

Companion Animals: Pet Food Ingredients - Mining, Dredging, and Extrapolating Effective Nutrient Delivery

566 Advances in evaluating pet food ingredients: Methodologies. G. C. Fahey, Jr.*, *University of Illinois*, *Urbana*.

Many ingredients exist that may be included in complete and balanced diets for pets. Dogs and cats are unique in that they can spend considerable numbers of years in the senior and (or) geriatric states, making the list of potential dietary ingredients even longer than would be the case for other species. It is important that ingredients be described in detail in order to allow for maximal utilization of their nutrients. Several levels of evaluation exist, beginning with a thorough analytical description of the ingredient. Modern analytical methods allow for near complete descriptions of macronutrients and micronutrients. In vitro testing constitutes the next level of evaluation and is very useful in predicting digestive physiological behaviors. The third level of evaluation is conducted in vivo with an animal model (e.g., use of the cecectomized rooster to determine true metabolizable energy and true amino acid digestibility values). The fourth and final level of evaluation is conducted with the target species and can take a number of forms: palatability, growth performance, and tolerance assays; digestibility evaluations, both ileal and total tract; balance studies; and gestation/lactation performance tests.

Key Words: Pet, Nutrient Bioavailability, Ingredients

567 AntiNutrients: Factors limiting utilization of nutrients in pet food ingredients. C. M. Grieshop* and G. Kuhlman, *The Iams Company*, *Lewisburg, OH*.

Companion animal nutritionists face many of the same challenges as other species animal nutritionists regarding the need to understand and correctly process ingredients used in their diet formulations. As with many farm animal diets, certain ingredients contribute antinutritional factors that require unique handling practices or formulation strategies to allow their optimal use. Many of the vegetable protein sources commonly used in farm animal diets (ie.soybean meal and corn gluten meal) are also used in companion animal diets and as with all species, unique amino acid composition or particular nutrient inhibitors, (ie.trypsin inhibitor in soybean meal) must be accounted for and properly handled before these ingredients can be used in companion animal diets. When ingredients such as these are incorporated into pet food diets the same precautions must be taken to deal with antinutritional factors as with diets of most species. In addition, some of the more unique ingredients that are used in companion animal diets also offer challenges in obtaining maximal nutritional value. Chicken by-product meal; a major protein source found in many companion animal diets, can be extremely variable in digestibility due to: different processing conditions, time of year the birds are harvested, type of bird used, and content. Another commonly used protein source, fishmeal, can be highly variable in salt and fatty acid content. In addition, companion animals have unique vitamin and mineral requirements as it has recently been realized that due to very poor bioavilability, copper sources obtained form copper oxide should not be considered when meeting the copper needs of the cat. Further confounding these issues, is the fact the pet food diets are most often produced under high temperature high moisture conditions and these processing variables can alter starch cook, nutrient availability and overall product digestibility. Raw material quality, processing conditions, and final diet content can all play a significant role in the ability of the animal to optimally utilize all available nutrients.

Key Words: Trypsin Inhibitor, Phytate, Biogenic Amines

568 Proteins: Advances in rendering animal and marine products. C. R. Hamilton* and D. Kirstein, *Darling International Inc.*, *Irving, TX*.

The United States rendering industry (RI) annually processes over 23.6 million t of animal byproducts and mortalities to make 45,000 t of red meat and 4 million t each of animal proteins (AP) and animal fats. Research to improve the nutritional value of AP and develop novel proteins is sponsored by both industry and individual companies. Industry research is managed by the Fats and Proteins Research Foundation (FPRF) and the Animal Co-Products Research and Education Center at Clemson University (ACREC). Research from FPRF studied factors affecting AA digestibility of conventional AP. For meat and bone meal (MBM), AA digestibility is affected by processing temperature, but not by specie the raw material was derived from or ash content. Reducing processing temperature improved total essential AA digestibility 9.1%. Other processes to improve the value of AP in pet food include air classification to make low-ash AP and blending AP to improve nutrient consistency. Enzymes may improve digestibility and antigenicity by hydrolyzing fish, poultry or mammalian proteins. Enzymatic hydrolysis of beef protein resulted in low molecular wt peptides (31.7% < 2,000 Da; 88.9% < 10,000 Da). A primary focus of ACREC is improving the microbial safety of rendered products to support a Code of Practice (COP) adopted by the RI. Facilities certified under this COP must comply with government regulations and demonstrate use of certain good manufacturing practices (GMP) and HACCP-like programs. Issues which restrict use of traditional AP in pet food include consumer acceptance of AP in pet foods, bovine spongiform encephalopathy (BSE), trends to use only products derived from animals inspected and passed for human consumption and pending regulations. Regulatory issues, consumer pressures and lost markets have caused the RI to preferentially fund ACREC research that focuses on development of new, non-nutritional uses for animal proteins. For the RI to also develop new and novel products for pet food, the pet food industry must commit to pay for their value and utilize sufficient volumes of such new products.

Key Words: Rendering, Animal Proteins, Pet Food

569 Fatty acids: Approaches to prevent or modify nutrient damage from oxidation. R. G. Brannan*, *Ohio University*, *Athens*.

Petfood fatty acids provide energy and essential dietary fatty acids which, however, are prone to lipid oxidation. Lipid oxidation is a chemical process catalyzed by free radicals formed from reactive oxygen and nitrogen or other pro-oxidants such as enzymes or transition metals. Primary products of lipid oxidation are lipid hydroperoxides, which decompose into many secondary products that research has shown may be efficiently absorbed in the intestine. Consumption of oxidized fatty acids may promote an increase in cellular oxidative stress which could lead to the promotion of oxidation-related disease syndromes. Fatty acids in petfoods can be from meat or added in bulk or emulsified form. Meat, especially precooked and restructured meat products, have low oxidative stability. The type of fatty acids from bulk oils or emulsified systems is often determined by nutritional targets that focus on n-3 and n-6 fatty acids ratios and the presence of essential fatty acids such as eicosapentaenoic acid (EPA) and docosahexaenoic acid (DHA). Thus, vegetable and marine oils are often chosen due to their high unsaturated and n-3 levels. However, vegetable and marine oils suffer from high susceptibility to oxidation, a condition that is exacerbated during storage at ambient temperature. There are many antioxidant choices that can be utilized in fatty acid-containing petfoods. Free radical scavengers detoxify free radicals produced during lipid oxidation. Metal chelators, singlet oxygen quenchers, and enzyme inhibitors all work to inhibit lipid oxidation catalysts. Certain other molecules work synergistically with antioxidants to enhance or prolong antioxidative activity. Regardless of the type, these antioxidants can be naturally derived or synthetic. However, the efficacy of any antioxidant system will necessarily depend on other physical and chemical factors such as location, interactions with other ingredients, and environmental conditions. Approaches to prevent or modify oxidative damage to fatty acids must take into account both the chemical reactivity of the antioxidant and the physical environment of the system.

Key Words: Fatty Acid, Lipid Oxidation, Antioxidants

570 Minerals: Effect of form on requirements and bioavailability. L. L. Southern*, *LSU Agricultural Center*, *Baton Rouge, LA*.

Organic (non-salt) trace minerals have been reported to have positive effects on reproduction, immunity, overall productivity, and integrity of hair, skin and hooves. Organic trace minerals are widely used in the dairy, swine, and poultry industries by feeding consultants, and by large animal enterprises. Seemingly, these entities would only use these minerals if economic value was obtained. Unfortunately, there is not a lot of comparative scientific data to support these suggestions. In general, organic trace minerals (depending on source) are more bioavailable than inorganic minerals. This response is based primarily (but not always) on tissue mineral concentrations. However, the higher bioavailability of organic trace minerals would not seem to account for some of their proposed benefits. Examples of results among different species for the trace minerals Zn, Mn, Cu, Se, Cr, and I will be discussed. For example, organic Zn fed during lactation increased number of pigs born alive and improved immune status of the pigs, but data are limited. Organic Mn and Cu are usually more bioavailable, based on slope ratio technique for tissue concentrations, than inorganic Mn and Cu (usually the sulfate form), but there is very little comparative scientific data to assess the proposed benefits of organic Mn and Cu supplemented as the only organic mineral in the diet. Organic Se supplementation results in greater tissue concentrations of Se, but inorganic forms have equal or greater efficacy in affecting GPX activity. In broilers previously fed organic Se compared with those fed inorganic Se, tissue Se concentrations and GPX activity were greater when the broilers were subsequently fed a Se deficient diet. Organic Cr supplementation decreases plasma glucose levels, increases glucose clearance rate, and improves numbers of pigs born - these responses are relatively consistent. Excess iodine intake of dams at levels well below those considered toxic may have negative effects on the offspring. Where applicable, how these results may apply to companion animals and the selection of trace mineral form will be highlighted.

Key Words: Organic Trace Minerals

Dairy Foods: Chemistry and Microbiology

571 Protein interactions in heat-treated milk and effect on rennet coagulation. P. Kethireddipalli* and D. G. Dalgleish, *University of Guelph*, *Guelph, ON, Canada*.

The underlying molecular processes that cause impaired rennet clotting of heat-treated bovine milk were investigated. Firstly, the effect of whey protein(WP)/ κ-casein complexes bound to the casein micelle, on the elastic modulus (G') and gelation times (T) of renneted heat-treated milk was examined. Milks with different levels of micelle-bound WP (<5% to ~80%) were produced by heating skim milk at 90°C for 10 min at pH values ranging from 6.3 to 7.1. WP was quantified using SDS-PAGE. Lower pH produced higher micellar WP association and vice versa. Using oscillatory rheometry, we found that compared to unheated milk (G', 83.5 Pa; T, 10 min) all heat-treated milks, after renneting, showed a remarkable reduction in G' (0.1 to 2.1 Pa) and a large increase in T (55 to 130 min). It did not seem to matter if the WP/ κ-casein complexes were predominantly bound to the casein micelle (pH 6.3) or were largely present as soluble protein complexes in the lactoserum (pH 7.1). In the second part, the individual effects of casein micelles and lactoserum on the rennet gelation properties of heated milk were investigated. Two different milk systems were examined; one was prepared by re-suspending casein micelles from milk heated at pH values 6.3, 6.7, or 7.1 in native serum from unheated milk, and the other contained native micelles from unheated milk in the serum from the various pH- and heat-treated milks. Heat- and pH-modified casein micelles suspended in normal serum significantly lowered the G' values of the resulting rennet gels. With the exception of pH 6.3, the heated lactoserum also interfered with gelation of heat-treated milks. In the final part of the study, the serum from heat-treated milks was further examined after its ultrafiltration (removes WP/ κ-casein complexes) or its dialysis against unheated milk (restores ionic composition). Both these processes significantly improved serum performance. This clearly demonstrated that not only serum ionic factors, but also serum WP/ κ-casein complexes, and heat-modified casein micelles (with or without associated WP) significantly interfere with the rennet gelation of heat-treated milks.

Key Words: Heat-treated Milk, Rennet, WP/κ-casein Complexes

572 Flavor variability and stability of US-produced whole milk powder. M. A. Lloyd* and M. A. Drake, *North Carolina State University*, *Raleigh*.

Whole milk powder (WMP) produced in the United States (U.S.) is used both domestically and internationally. Much of the available literature on WMP was generated using internationally produced WMP. Flavor variability and stability of US-produced WMP has not been characterized. The objectives of this study were to characterize flavor and flavor variability of domestic WMP. Freshly produced WMP was collected from 4 production facilities at 5 timepoints over a year period. At each timepoint, two 23-kg bags from different production runs were collected. Each sample was analyzed initially and every 2 months for flavor profile, volatiles, color, water activity, and moisture over a year of storage. Samples were reconstituted to 10% solids using deodorized water for descriptive and volatile analysis. Volatile analysis was performed using solid phase microextraction (SPME) followed by gas chromatography/mass-spectrometry. Relative abundance was calculated for the following compounds, based on the internal standard recovery (2-methyl-3-heptanone): toluene, hexanal, 2-heptanone, heptanal, octanal, 2-nonanone, nonanal, 2-undecanone, delta-decalactone, and delta-dodecalactone. Descriptive analysis was conducted using a 10-member trained panel. All WMP were between 2-3% moisture and 0.11-0.25 water activity initially. WMP varied in flavor and volatile composition within and between production facilities ($p<0.05$). WMP had distinct flavor profiles initially, with varying levels of cooked, milkfat, and sweet aromatic notes ($p<0.05$). Several samples also had feed flavors. During storage, grassy and painty flavors developed while sweet aromatic flavor intensities decreased ($p<0.05$). Some WMP developed grassy or painty flavors as early as 4 months, and all samples developed painty flavor by 12 months. Painty and grassy flavors were confirmed by increased levels of lipid oxidation products such as hexanal, heptanal, and octanal ($p<0.05$). There is wide variation in flavor and flavor stability of U.S. WMP. Further research should be done to determine specific factors that can be controlled to optimize flavor and flavor stability.

Key Words: Whole Milk Powder, Flavor, Stability

573 The effect of pH and ionic calcium on the heat stability of sterilized and UHT milk. M. J. Lewis* and A. S. Grandison, *School of Chemistry, Food and Pharmacy, The University of Reading*, *Reading, Berkshire, UK*.

It has long been recognized that milk salts, in particular divalent cations and pH, are important factors in determining milk processing behavior, particularly in influencing the stability of the protein in aggregation, gelation and precipitation reactions, and in the fouling of heat exchanger surfaces with mineralized deposits. However, practical information supporting this is not so readily available and the much reported heat coagulation time is not easy to perform nor widely used in the dairy industry as a quality assurance indicator of heat stability. This paper investigates the role of pH and ionic calcium on heat stability issues during UHT processing and in-container sterilization of milk. It has been found that problems encountered at UHT conditions relate primarily to sediment formation and fouling, whereas those encountered during in-container sterilization relate to gelation and thickening, although a lesser amount of sediment is also formed. Thus it is hypothesized that different mechanisms are involved in the two processes. This is being further investigated by manipulating pH and ionic calcium in milk by methods such as calcium-removal, calcium fortification and addition of phosphate and citrate stabilizers. The changes in pH and ionic calcium brought about by these processes not only affect heat stability, but also influence Maillard reactions, especially during in-container sterilization, which might be detrimental to product quality. The aim is to provide some practical guidelines that can be used to predict the intrinsic stability of casein micelles to high temperature sterilization.

Key Words: Ionic Calcium, pH, Heat Stability

574 Isolation, composition and rennet-gelling functionality of milk fat globule membrane fractions from regular buttermilk, whey buttermilk, and washed cream buttermilk. B. Manion* and M. Corredig, *University of Guelph*, *Guelph, Ontario, Canada*.

There has been increasing evidence of the health benefits associated with the consumption of some components of the milk fat globule membrane (MFGM) (i.e. phospholipids and immunoproteins). The objective of this work was to characterize the composition and processing functionality of MFGM-rich fractions. Three different fractions were prepared from industrially-upscalable processes, namely, microfiltration of buttermilk (MFGM), concentration of whey buttermilk (WR) and buttermilk derived from washed cream (WBM). MFGM was prepared by concentration and diafiltration through 1.4 µm ceramic membrane of fresh buttermilk with 2% sodium citrate. WR was obtained by concentration of fresh buttermilk from whey cream through 0.1 µm PVDF membranes. WBM was prepared from cream reconstituted back to the original volume with water and recentrifuged, and then churned to obtain the serum fraction. Proximate analysis, electrophoresis, and phospholipids analysis by HPLC were used to characterize the composition of each fraction. The amount of MFGM-derived material was MFGM>WR>WBM (from high to low), in both proteins and phospholipids, and the MFGM fraction contained the lowest level of caseins. Soy oil (10%) emulsions were prepared with 3% WR and WBM, 0.5% Tween 20 and 3% MFGM with various levels of Tween added. The renneting behavior of recombined milk (to 3.3% protein from skim milk powder) with 4% oil was tested. Milk containing MFGM-emulsions created the stiffest gels and showed the earliest onset of gelation compared to the other recombined milks. On the other hand, milk with oil droplets covered with WR-stabilized emulsions formed gels with low elastic modulus and showed longer gelation times than the other treatments. These results demonstrated that differences in the composition of the MFGM material at the interface affect the renneting behavior of recombined milk.

Key Words: Milk Fat Globule Membane MFGM, Buttermilk, Rennet Gelation

575 Fat globule interfacial composition affects the texture and microstructure of rennet-induced casein gels. Z. Gaygadzhiev*, M. Alexander, A. Hill, and M. Corredig, *University of Guelph*, *Guelph, ON, Canada*.

Model systems, containing both fat globules and casein micelles, were prepared to study the interactions occurring between filler particles and protein networks in rennet-induced casein gels. Anhydrous milk fat was emulsified in solutions of sodium caseinate (NaCas) or whey protein isolate (WPI). Pre-gelation stages of rennet coagulation were observed using Transmission Diffusing Wave Spectroscopy (DWS). Gelation was studied using small deformation rheological measurements and gel microstructure was characterized with laser confocal microscopy. Systems containing WPI-stabilized fat globules reached the gelling point, as determined by the cross-over of G'/G'', earlier than those containing no fat globules (control), although the values of final storage moduli were of a similar magnitude for both systems. The light scattering experiments also revealed that the changes in the DWS parameters (1/l*, apparent hydrodynamic radius, mean square displacement slope) occurred earlier for systems containing WPI emulsified fat globules In contrast, emulsification of fat globules with NaCas greatly retarded the gelation process and inhibited aggregation of casein micelles.

Key Words: Modified Milk Fat Globule Membrane, Diffusing Wave Spectroscopy, Rheology

576 Acoustical emissions generated by *E. coli* bacteria. C. L. Hicks*[1], J. M. Stencel[2], H. Song[2], and F. A. Payne[1], [1]*University of Kentucky*, *Lexington*, [2]*Tribo Flow Separations*, *Lexington, KY*.

Escherichia coli 15q and 15cc bacteria in TSB medium, at 32°C for greater than 5 h was monitored using contact acoustic sensors (20 to 50 kHz and 50 to 200 kHz) attached to the sides of the growth vessel. Acoustical emissions generated by the bacteria was picked up as a waveform and each waveform was referred to as a 'Hit'. Hits were analyzed for rate of accumulation and periodic cycles. Fast Fourier transform analysis was used to calculate average peak frequency emissions. Initial analysis showed that Hit detection from the 20 to 50kHz sensor began within 5 min after the medium was inoculated with *E. coli* 15cc. Hit detection from the 50 to 200 kHz sensor became more apparent as the organism entered the log phase and displayed a linear natural log increase in Hits during the log growth phase. Periodic cycles of 1.66 sec and 33.6 sec were observed during the early stages of growth suggesting that *E. coli* 15cc was involved in uniform sequenced activities, possibly quorum sensing. The average peak frequencies data showed shifting in frequencies as the bacteria

moved from the lag, log, and stationary phases. Differences between *E. coli* 15q and 15cc could be observed within the first 60 min of incubation (20 to 50 kHz sensor) with 15q producing 7average peak domains (frequencies) and 15cc producing only 5. After 5 h of incubation 15q produced only one broad peak domain while 15cc generated one defined domain and two smaller domains. Average peak frequencies for *E. coli* 15cc and 15q were sufficiently different in frequency and intensity during the lag, log and stationary phases that specific strain identification might be possible. Thus, acoustic emissions from bacteria may be unique enough to acoustically fingerprint bacteria and result in a rapid assay method.

Key Words: Acoustic, Bacteria, Sensing

577 An assay system for probiotic lactic acid bacteria recognizing human blood type A-antigen that competitively excludes harmful intestinal bacteria. T. Saito*[1], N. Wakahara[1], H. Uchida[1], H. Kinoshita[1], Y. Kawai[1], H. Kitazawa[1], K. Miura[2], A. Horii[2], K. Kimura[3], and N. Taketomo[3], [1]*Graduate School of Agricultural Science, Tohoku University*, *Sendai, Miyagi, Japan*, [2]*Graduate School of Medicine, Tohoku University*, *Sendai, Miyagi, Japan*, [3]*Meiji Dairies Corporation*, *Odawara, Kanagawa, Japan*.

A new evaluation system for selecting probiotic lactic acid bacteria (LAB) with specific adhesion to human colonic mucin that recognizes different ABO-blood types was developed in our laboratory [1,2]. Sixteen strains including *L. gasseri* OLL2804 showed strong adhesion to human blood type-A antigen [GalNAc-α-1-3 (Fuc-α-1-2) Gal-] from the intestinal mucosa were selected from 283 probiotic strains using the biosensor, BIACORE, that employs surface plasmon resonance (SPR)[3]. Similarly, 16 and 11 strains of LAB were selected with strong affinity to human B-antigen [Gal-α-1-3 (Fuc-α-1-2) Gal-] and H-antigen [Fuc-α-1-2 Gal-], respectively [4]. At the same time, we surveyed for colonic harmful bacteria that recognize the blood type antigens (sugar moities on intestinal mucin) using the same BIOCORE recognition system as for OLL2804. Forty strains were isolated from the surface of human colon using TS, MRS, BL and XM-G agar medias incubating at 37°C for 24 hrs. Cells from isolated strains were analyzed using BIACORE against BSA-A (neoglycoprotein, BSA introduced A-antigen trisaccharide). After 16s RNA fragment sequencing, two strains of *Staphylococcus* sp. and one strain of *Escherichia coli* were identified as harmful bacteria recognizing the human blood type-A antigen. We are now determining competitive exclusion of them using OLL2804 in the human intestine. This new assay system will be useful in the selection of probiotic candidates for functional foods including yogurt.

Key Words: Probiotic Lactic Acid Bacteria, BIACORE, Human Blood Type

578 Glyceraldehyde 3-phosphate dehydrogenase (GAPDH) expressed on the cell surface of *Lactobacillus plantarum* LA 318 mediates adhesion to human colonic mucin. H. Kinoshita*[1], H. Uchida[1], T. Kawasaki[1], N. Wakahara[1], H. Matuo[1], Y. Kawai[1], H. Kitazawa[1], S. Ohmura[2], K. Miura[2], K. Shiiba[2], A. Horii[3], and T. Saito[1], [1]*Graduate School of Agricultural Science, Tohoku University*, *Sendai, Miyagi, Japan*, [2]*Department of Surgery, Tohoku University Graduate School of Medicine*, *Sendai, Miyagi, Japan*, [3]*Department of Molecular Pathology, Tohoku University School of Medicine*, *Sendai, Miyagi, Japan*.

Members of the genus *Lactobacillus* are often isolated from the alimentary canals and feces of man and animals and are used in fermented food as probiotics. We showed *L. plantarum* LA 318 isolated from human transverse colon is a potential probiotic bacterium that shows high adhesion to human colonic mucin (HCM) mediated by a surface cell wall protein (1). The adhesion test used the BIACORE assay. PBS-washed bacterial cells showed a significant decrease in adherence to HCM as did GHCl treated cells. The component in the PBS supernatant fraction adhered to the HCM and was shown to be a 40 kDa protein using SDS-PAGE. Using homology comparisons of N-terminal to sequence databases, this protein was identified as glyceraldehyde 3-phosphate dehydrogenase (GAPDH). The purified GAPDH adhered to the HCM. The data strongly suggests the GAPDH of the LA318 strain is the adhesin. It has been reported that pathogens, such as *Candida albicans*, possess GAPDH on their cell surface that show binding activity to fibronectin etc. There is no report showing GAPDH exist on the cell surface of *Lactobacillus* probiotics that recognize HCM. This is the first report of GAPDH expressed on the cell surface of lactobacilli that also adhere to mucin; suggesting *L. plantarum* LA 318 adheres to HCM using GAPDH binding activity to colonize the intestine. Because LA 318 strain possesses the same adhesin as pathogens, this may prevent these pathogens from infecting the intestine. This suggests this probiotic can be ingested by mouth to work effectively by replacing pathogens in the intestine; and may be used in probiotic food products including functional yogurt.

Key Words: Probiotics, Adhesion, Human Colonic Mucin

579 Development and optimization of food-grade antimicrobial lactic acid bacteria isolated from raw milk. A. Ichinomiya*, K. R. Nauth, and V. V. Mistry, *South Dakota State University*, *Brookings*.

Producing safe products and extending the shelf life by reducing or eliminating foodborne pathogens are a challenge for the food industry. To meet the growing consumer demand for safe and natural foods, natural protection based on antimicrobial agents has been added to the product. Nisin is the one such natural food preservative. Nisin is a peptide produced by certain strains of *Lactcoccus lactis* subsp. *lactis* during fermentation. It has antimicrobial activity against broad range of Gram positive bacteria such as Clostridia and Listeria. Today nisin is permitted by law to be added to foods in more than 50 countries. The present study was performed to isolate nisin–producing *Lactcoccus lactis* subsp. *lactis* from raw milk, to evaluate the isolates for antimicrobial activity against food spoilage organisms and selected food pathogens, and to develop optimum conditions for maximal antimicrobial production. Milk samples from the raw milk tank or cows on the university dairy farm were collected and screened by the agar overlay method. Identification of the isolates was observed by Gram staining, 4% sodium chloride MRS media incubation, arginine catabolism and catalase test. The activity of nisin was calculated by agar diffusion method that nisin–producing lactic acid bacteria inhibit *Lactococcus lactis* subsp. *cremoris* ATCC 19257 as a nisin sensitive indicator strain. Several nisinproducing lactic acid bacteria strains were found in the raw milk. For optimal production of nisin, *Lactococcus lactis* needs complex nutrition such as nitrogen and phosphate in the medium. They affected the nisin production and biosynthesis. Their

addition to media increased the antimicrobial activity. The component of the antimicrobial activity will be characterized and optimized in substrate containing milk, whey, or, permeate.

Key Words: Antimicrobial Agents, Nisin, Natural Preservative

580 Challenge testing the lactoperoxidase system against against a range of bacteria using different activation agents. L. W. T. Fweja, A. S. Grandison*, and M. J. Lewis, *The University of Reading*, *Reading, Berkshire, UK*.

Lactoperoxidase (LP) exerts antimicrobial effects in combination with H_2O_2 and either SCN^- or a halide. Garlic extract (GE), in the presence of ethanol (E), has also been used to activate the LP system. This study aimed to determine the effects of three different LP activation systems (LP/SCN^-/H_2O_2; LP/I^-/H_2O_2; LP/GE/E) on the growth and activity of three test organisms (*Staphylococcus aureus; Pseudomonas aeruginosa; Bacillus cereus*). UHT milk was used as reaction medium and the growth pattern of the organisms and a range of keeping quality (KQ) indicators (pH, titratable acidity, ethanol stability, clot on boiling) were monitored during storage at the respective optimum growth temperature for each organism. LP/I^-/H_2O_2 reduced bacterial counts below the detection limit shortly after treatment for all three organisms, and no bacteria could be detected for the duration of the experiment (35-55 hours). The KQ data confirmed that the milk remained unspoilt at the end of the experiments. LP/GE/E, on the other hand, had no effect on the growth or KQ with *P. aeruginosa*, but gave a small retardation of growth of the other two organisms, accompanied by small increases (5-10 h) in KQ. The effects of the LP/SCN^-/H_2O_2 system were intermediate between the other two systems and differed between organisms. With *P. aeruginosa* the system exerted total inhibition within 10 h of incubation, but the bacteria regained viability after a further 5 h, following a logarithmic growth curve. This was reflected in the KQ indicators which implied an extension of 15 h. With the other two bacteria, LP/SCN^-/H_2O_2 exerted an obvious inhibitory effect giving a lag phase in the growth curve of 5-10 h and KQ extension of 10-15 h. When used in combination, I^- and SCN^- clearly competed for LP system intermediates and displayed negative synergy with respect to both bacterial growth and KQ.

Key Words: Lactoperoxidase, Keeping Quality, Antibacterial

581 Characterization of immuno active peptides present in cell free preparations obtained from milk fermented by L. Helveticus. A. M. Tellez*[2,1], M. Corredig[3,1], L. Brovko[2,1], and M. Griffiths[2,1], [1]*University of Guelph*, *Guelph, Ontario, Canada*, [2]*Canadian Research Institue for Food Safety*, *Guelph, Ontario, Canada*, [3]*Food Science Department*, *Guelph, Ontario, Canada*.

Interest in the ability of bioactive peptides to impact on immune system has grown considerably in the past decade. Fermented milk has been proposed as a source of those bioactive compounds. The objectives of this research were to confirm the effect of bioactive compounds from milk fermented by Lactobacillus helveticus (LH-2) on the nonspecific host defense system, and purify and characterize the active peptides. For this reason, the cell free supernatant obtained from centrifugation of the fermented milk was tested and an in vitro study using macrophages (RAW 264.7 cell line) was performed. Cytokines production (IL-6, TNF-α±, and IL -1β), Nitric Oxide (NO) production and Phagocytosis effect were used as biomarkers. Cytokine production in culture supernatants was assessed by ELISA. Trypsin-hydrolyzed fermented milk was used as negative control, and bacterial lipopolysaccharide (LPS) was the positive control. Macrophages stimulated with supernatant showed higher production of cytokines and NO compare with LPS. Phagocytosis effect was positive for macrophages stimulated with supernatant (50.75 % ±1.2). The supernatant from fermented milk was analyzed using size exclusion chromatography (SEC) and nine fractions were collected. All fractions were tested for activity. Two fractions (excluded volume and a fraction eluting at 15 minutes) produced higher response when used to stimulate macrophages compared with the other fractions (0.37 and o.25 ng/µg of protein). These results confirmed fermenting milk with Lactobacillus helveticus (LH-2) improves bioactivity, and suggested that specific peptides released during fermentation enhance immune response by modulating macrophage activity.

Key Words: Fermented Milk, Bioactive Peptides, Biomarkers

Dairy Foods: On the Road from Analysis and Discovery of Functional Milk Bioactives to New Products and Health Outcomes

582 An approach to capturing and translating the biological activities and health outcomes of milk components. S. L. Freeman*, *University of California*, *Davis*.

Chronic disease, complex metabolic disorders and obesity dominate the current health landscape. Food has contributed to the problem and therefore food-based interventions offer great potential for not only preventing disease, but also promoting health. To translate the knowledge from analysis and discovery of functional milk bioactives to new products & health outcomes requires different methods, approaches and techniques for studying and validating benefits of these different milk components in a scientifically substantiated manner. Successfully modulating metabolism and immune protection through rational food ingredients and products offers novel solutions to lifestyle and food choices. Milk is an appropriate model for delivering health benefits because it has evolved to nourish, protect and promote infants to not only survive but also thrive. Fundamentally, the components of milk guide health at a time of extreme vulnerability following birth. Understanding milk from this perspective of how it interacts with different biological processes will enable the development of new food products to guide health in different target population. Integrating food science, molecular biology, physiology, nutritional and clinical aspects to capture and apply the knowledge generated is a key to the development and documentation of effective dairy products. The emphasis has to be on documenting the biological activity of different milk components and how they can be applied to measurable health benefits.

Key Words: Health Outcomes, Bioactive Ingredients, Translational Process

583 The glycome and the glycoproteome of milk. C. Lebrilla*, B. German, D. Mills, and S. Freeman, *University of California*, *Davis*.

Oligosaccharides and proteins are the third and fourth most abundant components in human milk. Surprisingly, oligosaccharides and glycoproteins have not been tradditionally well studied despite their importance as potential bioactive components in milk. The glycomic and glycoproteomic analyses of milk provide opportunities for understanding the role of milk in nutrition and as a potential source of bioactive compounds. New analytical tools are being developed that make the analysis of oligosaccharides and glycoproteins possible. Many of these tools are based on mass spectrometry and liquid chromatography separation. In this presentation, our approach to the analysis of glycans (oligosaccharide) and glycoprotein components of various types of milk from primates to humans will be discussed. Separation methods including nanoflow liquid chromatography and high performance mass spectrometry are employed to characterize the constintuents of milk. The milk of five mothers are examined for a period of several months. The oligosaccharide components, the proteins, and the glycoproteins are examined during the period. Changes in the protein expression of specific proteins are observed. The oligosaccharide constituents are relatively constant but very individually while the glycosylation on proteins change dramatically. The implications of these variations are discussed.

Key Words: Mass Spectrometry, Glycome, Glycoproteome

584 Production and use of high CLA foods in human health. D. E. Bauman*[1], C. Tyburczy[1], A. M. O'Donnell[1], and A. L. Lock[2], [1]*Cornell University*, *Ithaca, NY*, [2]*University of Vermont*, *Burlington*.

Consumers are increasingly aware of the link between diet and health, and the potential role for functional food components in disease prevention. Conjugated linoleic acid (CLA) has been identified as a bioactive component of dairy products that may benefit the maintenance of human health. The major CLA isomer in dairy products is cis-9, trans-11 (rumenic acid; RA), and it originates predominantly in the mammary gland by endogenous synthesis from rumen-derived vaccenic acid (trans-11 18:1; VA) via the enzyme D9-desaturase. Milk fat concentrations of RA can be markedly increased by manipulation of the cow's diet (e.g. polyunsaturated fatty acid-rich oils, lush pasture) and by selection of individuals naturally producing elevated levels. The content of RA varies with the total fat content of the dairy product; therefore, whole fat products such as cheese, ice cream and butter provide the most CLA to the dietary intake. Furthermore, the ratio of VA to RA is ~ 3:1 in milk fat, and VA can also be used for endogenous synthesis of RA in human tissues. When consumed as a natural component of the diet, the RA in milk fat has been consistently shown to have anti-carcinogenic and anti-atherogenic effects in biomedical studies using animal models of human disease. VA is the predominant trans fatty acid in milk fat and the fact that humans can convert it to RA provides a compelling explanation for the observed differences in epidemiological studies investigating the effects of natural and industrial derived trans fatty acids on coronary heart disease. Biomedical studies with animal models have also demonstrated that milk fat-derived VA is anti-carcinogenic through its conversion to RA. Nevertheless, extrapolating these results to humans has been limited and problematic because chronic diseases have long latency periods and often have no consensus biomarkers. Overall, dairy products enriched in CLA represent functional foods that offer potential benefits for human health and the prevention of chronic diseases.

Key Words: CLA, Milk Fat, Human Health

585 Sources and characteristics of milk fat globule membranes. R. E. Ward*, *Utah State University*, *Logan*.

In raw milk, the fat is dispersed as colloidal particles ranging in diameter from 0.1 μm to over 15 μm, each coated in a bilayer of plasma membrane which originates from the secretory cell. The estimated surface of milk fat globular membrane (MFGM) in one milliliter of whole milk is estimated to be 500 cm2. MFGM is found in significant quantities in dairy products such as cream, cheese, cheese whey, butter serum and buttermilk. In recent years, technologies have been developed to isolate fractions from these materials rich in MFGM, and the composition and ingredient functionality of the resulting material depends on the physical treatments applied. Utilization of MFGM as an ingredient is limited by its batch-to-batch variability and susceptibility to oxidation. The MFGM is composed of proteins and lipids in approximately a 1:1 ratio with a small contribution of non lactose carbohydrate. Recent proteomic analyses of the MFGM from human, bovine and murine milks have identified over one hundred unique peptides sequences associated with this material. According to gene ontology classifiers, proteins of the MFGM are involved in membrane trafficking, cell signaling, lipid metabolism, and defense against pathogens, as well as other processes. The lipid fraction of the MFGM is primarily composed of triglycerols, and polar lipids such as sphingomyelin, phosphatidylcholine, phosphatidylethanolamine, and phosphatidylinosotol with smaller amounts of phosphatidylserine, gangliosides and ether-linked lipids. The unique nature of the lipid secretion process, the vast surface area of MFGM in milk, and the growing list of bioactive constituents suggests potential nutritional functionality. MFGM is unique compared to other bioactive ingredients because of the compositional diversity and density of molecules associated with the surface. It is not unreasonable to expect synergisms in bioactivity among components, which would provide an interesting model for product development. Incorporation of MFGM and fractions thereof into foods will be expedited by scientific demonstration of beneficial bioactivity.

Key Words: MFGM, Bioactive

586 Fall growth potential of cereal-grain forages. J. L. Gunsaulis[1], W. K. Coblentz*[2], R. K. Bacon[3], R. K. Ogden[3], K. P. Coffey[3], D. S. Hubbell, III[4], J. V. Skinner, Jr.[3], and J. D. Caldwell[3], [1]*Arkansas Cooperative Extension Service*, *Fayetteville*, [2]*US Dairy Forage Research Center*, *Marshfield, WI*, [3]*University of Arkansas*, *Fayetteville*, [4]*Livestock and Forestry Branch Station*, *Batesville, AR*.

In Arkansas, producers utilizing cereal grains as fall forage for weaned calves usually do not produce a grain crop the following summer. Our objectives were to evaluate eight diverse varieties of wheat (*Triticum aestivum* L.), oat (*Avena sativa* L.), rye (*Secale cereale* L.), and triticale (X *Triticosecale* Wittmack) specifically for their potential to accumulate forage DM during the fall. All varieties were drilled into prepared seedbeds at Fayetteville and Batesville during early September of 2004 and 2005. Beginning in mid-October, plots were harvested for DM yield at 2-wk intervals that continued through December. Variety × harvest date interactions or tendencies for interaction ($P \leq 0.069$) were observed for all combinations of site and year. For Fayetteville 2004, triticale and oat varieties accumulated DM in a cubic ($P \leq 0.040$) pattern, most likely because growing tillers exhibited stem elongation, and then were susceptible to freeze damage in late December. Generally, wheat and rye varieties accumulated DM in less complex patterns over harvest dates, but the maximum numerical yield for any wheat variety was 2,554 kg/ha compared to 4,661 kg/ha for oat. For Batesville 2004 and Fayetteville 2005, DM yields for varieties ranked similarly, but respective overall mean yields (490 and 988 kg/ha) were only 25 and 50% of those for Fayetteville 2004 (1,960 kg/ha) due to drought. For Batesville 2005, favorable growing conditions coupled with a sharp mid-November freeze (-7°C), created yield responses that were unique relative to other site-years. Yield of DM increased quadratically ($P \leq 0.002$) for wheat, rye, and triticale varieties throughout the sampling period, accumulating a mean maximum yield of 4,148 kg/ha on the final harvest date. In contrast, oat varieties were especially sensitive to freezing temperatures in November, and averaged only 2,484 kg/ha on the same date. Producers requiring high-quality forage in the fall and winter can usually improve fall production by using oat or other species that exhibit stem elongation; however, this trait will likely increase susceptibility to freezing temperatures, thereby making continued growth into the winter or winter survival problematic.

Key Words: Cereal Grains, Yield

587 Increasing non structural carbohydrates in alfalfa improves in vitro microbial N synthesis. R. Berthiaume*[1], C. Benchaar[1], A. V. Chaves[3], G. F. Tremblay[2], Y. Castonguay[2], A. Bertrand[2], G. Bélanger[2], R. Michaud[2], C. Lafreniére[1], and A.F. Brito[1], [1]*Agriculture & Agri-Food Canada*, *Sherbrooke, QC*, [2]*Agriculture & Agri-Food Canada*, *Quebec, QC*, [3]*Agriculture & Agri-Food Canada*, *Lethbridge, AB*.

Insufficient readily fermentable energy in alfalfa reduces forage N use efficiency by ruminants. Our objective was to compare the effect of contrasting levels of non structural carbohydrates (NSC; sugars + starch) in alfalfa on rumen microbial fermentation. More than 500 genotypes from the alfalfa cultivar AC Caribou grown near Québec City were individually harvested at the late flowering stage. Harvested genotypes were transferred to a draft oven, dried at 55°C, and ground (1-mm). Samples were analyzed for soluble carbohydrates by HPLC and for starch using a colorimetric method. Genotypes having respectively the highest and lowest NSC concentrations (around 20 genotypes in each group) were pooled to constitute two contrasted 1-kg forage samples. Samples of high (170 mg/g DM) or low (66 mg/g DM) NSC were respectively allocated to separate dual flow fermenters (1300 mL) in a completely randomized design with 3 replications. Rumen inoculum was obtained from 4 ruminally fistulated cows fed a 50:50 forage to concentrate early lactation TMR (16.7% CP, 34.4% NDF). A 10-d incubation period was used with the first 6 d for adaptation followed by 4 d of sampling. Alfalfa digestibility (DM, OM, NDF, ADF and N), fermentation end-products (VFA, NH_3-N), pH and microbial protein synthesis (using ^{15}N as a microbial marker) were determined and results were analysed as repeated measures using the MIXED procedure of SAS. Increasing NSC concentration in alfalfa had no effect on digestibility but decreased ruminal pH (6.85 vs. 7.08; $P = 0.02$) and NH_3-N concentration (316 vs. 409 mg/L; $P = 0.04$), and increased the molar proportion of butyrate (11.6 vs. 9.0%; $P = 0.04$). More importantly, microbial N flow was higher with high than with low NSC alfalfa (0.306 vs. 0.270 g/d; $P = 0.03$). These results suggest that increasing the concentration of NSC in alfalfa enhances microbial N synthesis in the rumen.

Key Words: Alfalfa, Carbohydrates, In Vitro Fermentation

588 Effect of a biological silage inoculant on the quality parameters under laboratory and field conditions. Y. Acosta Aragón*, G. Boeck, A. Klimitsch, and G. Schatzmayr, *Biomin GmbH, Austria*, *Herzogenburg, Lower Austria, Austria*.

The silage quality (laboratory and field trials) and the silage quality and cost effectiveness (field trials) using a biological silage inoculant (BSI) were determinated. Three silage laboratory trials with three different raw materials were performed using a BSI (blend of hetero- and homofermentative bacteria). Grass, luzerne and whole plant corn (WPC) were ensiled in buckets (dry matter DM of 33-36, 52-56 and 29-33 %, respectively).The BSI was applied at a rate of 2×105 CFU/g of raw material and compared with other biological and chemical inoculants. The silos were opened after 2 or 3, 7, 14 and 50 days of ensiling. pH value, sugar and organic acids were analysed, as well as the aerobic stability. The control group produced less lactic and acetic acid (in all tested substrates) and more butyric acid (grass silage) than the group with the inoculant. BSI silages showed a better aerobic stability (7 days), low DM losses and no negative points compared to the control group. For the WPC silages, pH values in all treatments were low but the silage with BSI showed highest amount of acetic acid (31.4 g/kg DM) which results in good aerobic stability (7 days) without dry matter losses and no negative points. For field trials, the silages (grass, alfalfa and WPC) with very variable DM contents (from about 20 to more than 45 %) shown to have good parameters as low pH value (3.8-4.5), high lactic and acetic acid (about 60-70 and 10-30 g/ kg DM respectively) and lower butyric acid content (< 3 g/ kg DM), increasing the Net Energy for Lactation (NEL) content in about 0.05-0.18 MJ/ kg DM. To estimate the profit in use of the silage inoculants, the parameter NEL with or without the use of BSI was selected over the other silage quality parameters. The calculation of the profit estimation included the price of the used product (1.8 euros/

treated ton), the net energy and corresponding milk production plus. The profit per ton can reach up to 5.21 euros/ treated ton.

Key Words: Silage, Inoculant, Aerobic Stability

589 Molasses effects on Kochia scoparia characteristics as an Iranian native forage in the form of silage. B. Saremi*, A. R. Shahdadi, and H. Zaher Farimani, *Education center of Jihad-e Agriculture, Khorasan razavi,, Mashhad, Iran*.

The objective of this study was to introduce Kochia scoparia as native forage in Iran and to investigate characteristics of its ensiling with different amounts of molasses (0, 5 and 10 percent) via a factorial experiment based on a completely randomized design. Kochia scoparia was harvested from desserts around Sabzevar city in northeast of Iran (Khorasan-razavi) using Sabzaver Jihad-e agriculture branch facilities. This study was done at the education center of Jihad-e agriculture in Mashad city. Kochia was chopped at 8±1.25 cm and completely mixed with different amounts of molasses (According to as fed weight), then ensiled in experimental silos (polymer buckets, 40 cm height and 30 cm diameter). 24 experimental silos were divided between treatments (0, 5 and 10 percent molasses) and opened 1, 2, 3 and 21 days after ensiling. Samples were taken and pH was determined immediately using on farm pH meter (Greisinger electronics, GPHR 1400 A). Fresh samples were mixed with distilled water (1:1), and then pH was determined. Another sample was frozen for future chemical analysis. DM, OM, ADF, Ca and P were determined using standard methods. Data was analyzed using SAS 9.1 and means were compared using Duncan test ($P<0.05$). Results showed that silage pH decreased with increasing molasses levels ($P<0.0001$). Also pH was decreased with a low rate up to 21 days after ensiling in comparison with corn silage that received 4.5% molasses after 2 days. DM content increased with molasses addition but reduced with days after ensiling ($P<0.0001$). OM increased with addition of molasses ($P<0.0061$) but reduced with days after ensiling ($P<0.0015$). This was because molasses has a higher DM content with respect to Kochia and nutrients usage by silage micro flora increased with molasses addition. Ca content of silage was not affected by day or treatments.

Table 1. Chemical composition of ensiled Kochia scoparia with different amounts of molasses in various days

Items	% Molasses				SEM
	0	5	10		
pH	6.46[a]	4.98[b]	4.70[c]		0.024
DM (%)	38.85	40.11	43.57		0.248
OM (%)	87.14[b]	87.53[b]	88.1[a]		0.155
Ca (mg/ml)	0.757	0.753	0.825		0.052
	Days				
	1	2	3	21	
pH	6.22[a]	5.52[b]	5.21[c]	4.57[d]	0.027
DM (%)	39.53[b]	38.4[c]	38.12[c]	37.08[c]	0.286
OM (%)	88.04[a]	87.81[a]	86.92[b]		0.155
Ca (mg/ml)	0.732	0.745	0.858		0.052

Means with different letters have significant difference in each row ($P<0.05$)

Key Words: Kochia scoparia, Molasses Treatment, Silage

590 Feeding value of silage made from Panicum maximum with or without Leuceana leucocephala or Gliricidia sepium as supplementary feeds for weaned rabbits. A. M. Raji*[1,2], A. T. Adesogan[1], J. A. A. Sansi[2], and R. A. Salako[2], [1]*Department Animal Sciences, University of Florida*, *Gainesville*, [2]*Federal College of Animal Health and Production Technology, IART*, *Ibadan, Oyo, Nigeria*.

Ensilage is one of the methods that have been employed to conserve or preserve excess forages for use during the period of scarcity in term of quality and quantity in most tropical countries. Three different silage products were prepared using the mixture of Panicum maximum and Gliricidia sepium (A), Panicum maximum and Leucaena leucocephala (B); and panicum maximum alone (C), which served as the control experiment. The silages were opened after 4 months of ensilage and fed to weaned rabbits as supplements. The treatment diets were grouped in A, B and C. The feeding trial lasted for 12 weeks. The daily feed intake, refusal, and weekly weight gain of the experimental animals was measured. Significant ($P<0.05$) variations were noted among the treatment diets for nutrient composition, silage properties, feed intake and weight gained by the rabbits. The ADF of the silage produced ranged from 16.7% for treatment diet C to 35.6% for B, while the NDF ranged from 21.3% for treatment A to 40.5% for treatment C. The CP content of the silage prepared ranged from 6.5% for treatment C to 14.4% for treatment B. pH was raised with the inclusion of the browse plants . It ranged from 4.09 for C to 4.20 for A. Feed intake (g/DM) varied widely, it ranged from 62.6 for A to 99.4 for B while the weight gained/day/animal was highest for rabbits on treatment diet B (7.8g), while rabbits on A (2.4g) gained least. The raised pH value from grass alone versus grass/legume mixture is an indication of the influence of lactic acid production during fermentation of the product. This is an added advantage for effective preservation. The reduced feed intake of diet A is, however, unexpected and could be a result of mimosine breakdown during fermentation that resulted in unpalatable end product. These subsequently reduce the acceptability of the silage by the animals thus leading to reduced feed intake, eventually resulting in weight loss. The study revealed an improved performance of rabbits in terms of weight gain and quality of silage produced when G. sepium and P. maximum were combined.

Key Words: Silage, Panicum Maximum, Rabbit

591 Water soluble carbohydrates relative to protein in fresh forages: Impact on efficiency of nitrogen utilization in lactating dairy cows. D. Pacheco*[1], G. A. Lane[1], J. L. Burke[2], and G. P. Cosgrove[1], [1]*AgResearch Grasslands*, *Palmerston North, New Zealand*, [2]*Massey University*, *Palmerston North, New Zealand*.

Nitrogen utilization efficiency for milk production (NUEm: g milk N per g of N intake) in systems based on grazing of temperate forages is lower than in systems based on concentrates and conserved forages. Forages with higher content of water soluble carbohydrates (WSC) have been proposed as a solution to increase the efficiency of conversion of dietary nitrogen into milk with concomitant reduction on the environmental impact of excreta nitrogen. We have conducted a series of experiments over 2 years to study the role of WSC for pasture-fed cows in New Zealand. In our experiments, NUEm estimated at different times of the year has failed to show consistent, significant differences among grasses with differing concentrations of WSC (diploid perennial [*L. perenne*] and tetraploid annual ryegrasses [*L. multiflorum*] with

″high″ WSC, compared with a diploid perennial ryegrass control). Meta-data (n=129, each one the mean of an experimental group of animals) from our experiments to-date has been examined to find possible explanations for the lack of consistent responses to the WSC. A regression tree analysis was performed (partition 70:30 in the data for training and validation), to predict NUEm from the values of chemical composition of the forage on offer at times of milk sampling (CP, fat, ADF, NDF, WSC, and ash % of DM; from NIRS). Splitting of nodes was constrained to $P<0.10$, resulting in 2 rules for classification ($r^2= 0.56$, validation data set). CP values higher than 23.2 % DM resulted in mean NUE of 0.20, while CP values below 23.2 % DM resulted in mean NUEm of 0.25. In the latter group, a mean NUEm of 0.23 was obtained from the subset with WSC lower than 21% DM; while WSC content higher than 21% resulted in a mean NUEm of 0.27. The analysis suggests that benefits of high WSC concentrations on NUEm are more likely to occur below a CP content threshold in fresh forages, regardless of the cultivar.

Key Words: Nitrogen Utilization, Fresh Forages, Water Soluble Carbohydrates

592 Contribution of plant mediated proteolysis to total protein degradation of fresh forages in the rumen of dairy cows. D. Pacheco*, W. C. McNabb, H. S. Easton, and B. Barrett, *AgResearch Grasslands*, *Palmerston North, New Zealand*.

Ruminal degradation of proteins in grazed forage is caused by intrinsic and extrinsic proteolytic processes mediated by plant and ruminal microorganism enzymes, respectively. The objective of this experiment was to measure the contribution of intrinsic proteolysis to the total crude protein (Nx6.25) degradation in tall fescue (FS: *F. arundinacea*), red clover (RC: *T. pratense*), perennial ryegrass (RG: *L. perenne*), and white clover (WC: *T. repens*) leaves. Representative leaf samples were harvested from field grown plots over four consecutive summer days, for use in *in sacco* incubations in a balanced design with 2 cows. Grass leaves were chopped into 1 cm segments, legume leaves were picked and left undamaged. Samples were sealed in permeable (Dacron 50 micron pore size) and impermeable (polyethylene) bags and incubated for 0, 1, 2, 3, 4, 6, 8, 12, 18 and 24 h. Protein degradation was measured by analysis of the residues in retrieved bags. For each forage, samples exhibited higher protein degradation levels ($P < 0.01$) in the permeable treatment than in the impermeable one. Plant-mediated protein degradation in the impermeable treatment was confirmed by the recovery of amino acids (170 (SE 15.7); 110 (SE 18.3); 177 (SE 9.2) and 251 (SE 66.6) mg total amino acids/g CP) at 24 h for FS, RC, RG and WC, respectively. Protein degradation measured in the permeable treatment bags was higher ($P < 0.05$) than the impermeable one after 6, 12, 8 and 6 h for FS, RC, RG and WC, respectively. Plant-mediated proteolysis estimated from asymptotic values of the degradation curves reached 0.26 (FS: SE 0.028); 0.14 (RC: SE 0.075); 0.33 (RG: SE 0.07) and 0.35 (WC: SE 0.029) of the initial amount of protein incubated. These values accounted for 0.34, 0.16, 0.41 and 0.42 of the asymptotic value for protein degradation measured from the permeable treatment, respectively. Variation in plant-mediated proteolysis deserves further exploration as a tool for improving nitrogen usage in the fresh-forage fed ruminants.

Key Words: Protein Degradation, Forages, Dairy Cows

593 Relationships between silage fermentation characteristics and feed intake by dairy cows. I. Eisner[1], K.-H. Suedekum*[2], and S. Kirchhof[1], [1]*University of Kiel*, *Kiel, Germany*, [2]*University of Bonn*, *Bonn, Germany*.

The feeding value of silage is defined mainly by the contents of net energy for lactation, crude protein and cell wall components. In addition, the quality of silage is determined by fermentation products. A number of experiments have shown that the varying concentrations of these attributes affect feed intake. Unfortunately, the results are controversial. Therefore, this study had the objective to quantify the effects of fermentation end products on intake of grass, corn, and legume silages based on a meta-analysis of literature data. In addition, the accuracy of multiple regression models was tested by including silage fermentation characteristics into equations for feed intake prediction. The meta-analysis revealed that the concentration of acetic acid was closely and negatively correlated with silage intake when concentrate and forage were offered separately. These results supported previous studies in which acetic acid was supplemented directly into the silage before feeding. The effects of other short-chain fatty acids and of lactic acid and ammonia were unclear. Literature data were either controversial or effects were affected by collinearity between fermentation products. Protein quality appears to be an important factor for feed intake. Proteolysis during ensiling has increased the concentration of soluble nitrogen in silage and has consistently reduced silage intake. Amines have been suggested as being responsible for reduced silage intake but experimental evidence so far did not support this hypothesis. Total acid concentration was closely and negatively related to total feed intake in diets fed as total mixed rations (TMR). In the data set used for the meta-analysis of diets with forage and concentrate offered separately, inclusion of the acetic acid concentration in a model with animal-associated factors such as milk yield and body weight resulted in an improved accuracy of the prediction of total feed intake. The total acid concentration was the best factor that increased the fit of a model for feed intake prediction when diets were fed as TMR. In conclusion, current equations for feed intake prediction need and warrant further development.

Key Words: Silage, Intake, Fermentation

594 Alfalfa harvested in the afternoon increases performance of lactating dairy cows. A. F. Brito*[1], G. Tremblay[2], D. R. Ouellet[1], A. Bertrand[2], Y. Cantonguay[2], G. Belanger[2], R. Michaud[2], H. Lapierre[1], and R. Berthiaume[1], [1]*Dairy and Swine R&D Centre, Agriculture and Agri-Food Canada*, *Sherbrooke, QC, Canada*, [2]*Soils and Crops R&D Centre, Agriculture and Agri-Food Canada*, *Ste-Foy-Normandin, QC, Canada*.

Alfalfa (*Medicago sativa*) harvested in the afternoon has been shown to have greater concentration of total nonstructural carbohydrates (TNC) than that harvested in the morning. Our objective was to determine the effects of alfalfa cut either in the afternoon (PM, 1800) or in the morning (AM, 0600) on performance and ruminal metabolism of lactating dairy cows. Alfalfa was conserved as silage (50% DM) into individually wrapped large rectangular bales. Sixteen multiparous Holstein cows (8 ruminally cannulated), in mid to late lactation, were assigned in a crossover design (24-d periods) to one of two treatments: PM vs. AM silage. Cows were fed only silage that contained on average (g/kg DM) 211 vs. 214 CP and 126 vs. 99.3 TNC for PM vs. AM, respectively. Dry matter intake (DMI), and yields of milk, milk protein

and milk fat were greater with PM than with AM silage. Reduced milk urea nitrogen (MUN) with feeding PM compared to AM silage indicates improved N utilization. Ruminal pH tended to be lower on AM than on PM silage; this was probably associated to the increased ruminal acetate and total volatile fatty acids (VFA) on alfalfa cut in the morning. The greater ruminal acetate:propionate ratio observed with AM silage suggests that ruminal metabolism was shifted towards lipogenesis. Overall, increased alfalfa silage TNC content with afternoon harvest resulted in improved performance of dairy cows.

Table 1.

Item	AM silage	PM silage	SED	*P*
DMI, kg/d	18.8	20.0	0.22	<0.01
Milk yield, kg/d	19.2	20.1	0.18	<0.01
Milk protein, %	3.22	3.24	0.02	0.37
Milk protein, kg/d	0.61	0.65	0.01	<0.01
Milk fat, %	3.96	4.04	0.08	0.31
Milk fat, kg/d	0.75	0.82	0.02	<0.01
MUN, mg/dL	18.9	17.2	0.27	<0.01
Body weight gain, kg/d	0.55	0.23	0.08	<0.01
Ruminal pH	6.34	6.41	0.04	0.09
Ruminal acetate, m*M*	66.7	63.5	0.96	0.02
Ruminal propionate, m*M*	15.8	15.3	0.25	0.10
Ruminal butyrate, m*M*	6.36	6.14	0.13	0.13
Ruminal total VFA, m*M*	91.6	87.9	1.27	0.02
Ruminal acetate:propionate ratio	4.27	4.17	0.04	0.05

Key Words: Alfalfa Silage, Diurnal Harvest, Total Nonstructural Carbohydrates

Goat Species

595 *In vitro* larval activity and *in vivo* gastro-intestinal parasites infestation in goats grazing tropical legumes. K. A. H. Valentin*[1], B. R. Min[2], E. Valencia[1], A. Rodriguez[1], W. E. Pinchak[2], J. E. Miller[3], and J. P. Muir[4], [1]*University of Puerto Rico*, *Mayaguez, Puerto Rico*, [2]*Texas Agricultural Research Center*, *Vernon*, [3]*Louisiana State University*, *Baton Rouge*, [4]*Texas Agricultural Research Center*, *Stephenville*.

In Exp. 1, eight naturally parasite-infected growing Boer goats were randomly allocated to two treatments. One treatment (n = 4; initial LW = 18.8 ± 0.5 kg) entailed grazing of Arachis (*Arachis pintoi*) from September to December 2006 with a second treatment of Calliandra (*Calliandra calothyrsus*) (n = 4; initial LW = 14.4 ± 0.5 kg) grazing up to 84 days. In Exp. 2, three purified tannins (Calliandra, lespedeza (*Lespedeza cuneata*), and Acacia (*Acacia angustissima* var. hirta) and commercially available tannin monomers (ellagetannin, gallotannin, and catechin) were used *in vitro* to determine the effect of legume forage tannins and monomers on the larval migration inhibition (LMI %) rates of infective third-stage larvae of *Haemonchus contortus* (*H. contortus*). For the *in vitro* study, Calliandra was chosen because of anthelmentic activity measured in Exp. 1, while, Lespedeza and Acacia tannins were included because of known anthelmentic activity. Exp. 1 mean fecal egg counts (5262 vs. 7644 eggs/g; $P < 0.001$) and FAMACHA score (2.5 vs. 2.9; $P < 0.02$) were lower for Calliandra than for Arachis. ADG (11.1 vs. -34.7; $P < 0.02$) and packed cell volume (22.3 vs. 20.5; $P = 0.13$) were greater for Calliandra than for Arachis, respectively. *In vitro* DM digestibility was lower ($P < 0.001$) for Calliandra but crude protein and condensed tannins were greater ($P < 0.01$) than for Arachis. In the presence of 2 and 4 mg purified tannin/ml (using a Sephadex LH-20), LMI rates of *H. contortus* increased with Lespedeza and Calliandra extracts. There was no dose response of Acacia extract on LMI. *H. contortus* exhibited dose dependent ($P < 0.01$) response to 1, 2, and 4 mg/ml of ellagetannin, gallotannin, catechin tannin monomers though differential inhibitory activity was observed: ellagetannin > gallotannin > catechin.

Key Words: Gastrointestinal Nematodes, Tannins, Tropical Legumes

596 Effects of hay inclusion on intake, total tract nutrient utilization and ruminal fermentation of goats fed spineless cactus (Opuntia fícus-indica Mill) based diets. E. L. Vieira[1], A. M. Batista[1], A. Guim[1], F. F. Carvalho[1], A. C. Nascimento[1], R. F. Araújo[1], and A. F. Mustafa*[2], [1]*Universidade Federal Rural de Pernambuco*, *Pernambuco, Brazil*, [2]*McGill University*, *QC, Canada*.

A study was conducted to determine the effects of increasing levels of tifton bermudagrass hay in cactus-based diets on total tract nutrient utilization and ruminal fermentation parameters of goats. Five ruminally fistulated goats were used in a 5 × 5 Latin square experiment with 17-d periods. Experimental diets contained (g/kg) 765, 670, 572, 473 and 373 spineless cactus and 50, 150 250, 350, and 450 tifton bermudagrass hay, respectively. Results showed that that DMI increased qudratically (P<0.05) while intake of OM, CP and NDF increased linearly (P<0.05) as the level of hay in the diet increased. However, intake of non-fiber carbohydrates (NFC) decreased quadratically (P<0.05) as a result of hay inclusion. Total tract digestibility of DM (average 70.6%), OM (average 73.7%), CP (average 80.4%), NDF (average 55.3%), and NFC (average 90.4%) were not influenced by hay level in the diet. Nitrogen retention was similar for all dietary treatments, however, N supply to the small intestine increased quadratically (P<0.05) as the level of hay in the diet increased. Hay inclusion linrealy increased (P<0.05) ruminal pH and NH3-N concentration, and rumen content of DM and NDF. Rumen turnover of DM and NDF quadratically decreased (P<0.05) while rumen disappearance of DM and NDF increased quadratically (P<0.05) as the level of hay in the diet increased. It was concluded that inclusion of tifton bermudagrass hay in high cactus diets improved feed inake without adversely affecting total tract nutrient urilization or ruminal fermentation. A minimum of 150 g/kg of hay should be included in high cactus diets to avoid digestive disturbances and maximize feed intake.

Key Words: Goats, Nutrient Utilization, Spineless Cactus

597 Evaluation of Chevon on risk factors for coronary heart disease. D. D. Burnett*, S. B. White, M. M. Corley, and R. N. Corley, III, *Tuskegee University*, *Tuskegee, AL*.

Chevon (goat meat) is consumed world-wide and consumption in the United States has increased recently due to many factors including its potential as a healthy alternative to traditional meats. Goats deposit most of their fat internally versus intramuscularly in other livestock species thus chevon contains relatively less fat than other meat products and appeals to health conscious consumers. The serum lipid profile represents the types and amounts of circulating lipids, and in general meat fats have been implicated in the elevation of circulating lipids particularly LDL and total cholesterol (TC) fractions. This is associated with an increased risk for Cardiovascular (CVD), which is the leading cause of death in the United States. Over 50% of deaths from CVD result from Coronary Heart Disease (CHD), a major form of CVD in which diet plays a pivotal role. The objective of this study was to evaluate chevon as a primary protein source on risk factors for CHD. Fifty male Golden Syrian hamsters 4-weeks in age were randomly assigned to one of 5 dietary treatments. Retail meat cuts were used in diet formulation with lean beef, pork, chicken, chevon or casein serving as the sole protein source. Diets were fed ad libitum for twenty-eight days and voluntary feed intake (VFI) and average daily gain (ADG) was recorded. On day 28, the hamsters were fasted for 24 hours, euthanized and blood was collected for plasma lipid analysis. VFI for chevon was lower ($P<0.05$) than for all other diets. VFI for casein was 4.7% lower than beef and pork and was similar to chicken. ADG was 12.9% higher ($P<0.05$) for the animals consuming the beef and pork diets compared to chevon, chicken and casein, which supported similar gains ($P>0.05$). Plasma levels of LDL, HDL, and TC were not influenced by diet ($P>0.05$). Chevon did not affect the serum lipid profile, although it is important to note that the lean meat cuts in this study appeared to be heart healthy relative to casein. Future research will include the use of more economical cuts of meat in diet formulation and to determine the contribution of endogenous lipids to the serum lipid profile as affected by diet.

Key Words: Chevon, Cardiovascular Disease, Serum Lipid Profile

598 Effects of stabilized rice bran on growth, feed efficiency, carcass characteristics, and occurrence of urinary calculi in wether Boer goats fed a complete pelleted diet. G. V. Pollard*[1] and R. V. Machen[2], [1]*Texas State University*, *San Marcos*, [2]*Texas Agricultural Experiment Station*, *Uvalde*.

Sixteen wether Boer goats individually penned were utilized in a 102 d study to determine the effects of stabilized rice bran (RB) on ADG, feed efficiency, carcass characteristics, and occurrence of urinary calculi. Treatments evaluated were: control (no added RB), 45 g/d RB, 90 g/d RB, and 135 g/d RB, these diets accounted for 0, 0.8, 1.6, and 2.4 g supplemental P/d, respectfully. Goats were fed at 3.25% BW for 102 d once daily with free choice access to water and weighed every 14 d. Any goat that developed symptoms of urinary calculi was treated for the blockage and to alleviate symptoms. Goats that died were necropsied and stones were collected and bladders examined for evidence of rupture. On d 102 all goats were shipped to a commercial slaughter plant where carcass data were collected. Data were analyzed as a randomized design using the GLM procedure of SAS. Goats fed the control diet and 45 g/d RB had greater ($P =0.041$) overall ADG, FG, and 102 d live weights than those fed 90 g/d RB or 135 g/d RB. A primary area of interest in this study was the relationship between RB and occurrence of urinary calculi. In total five goats developed calculi on this study, three (two deaths) on the 135 g/d RB treatment and two (one death) on the 90 g/d RB treatment. Goats receiving the control and 45 g/d RB had greater ($P = 0.035$) hot carcass weight than goats fed the 90 g/d and 135 g/d RB diets. Fat thickness (FT) and leg circumference (LC) did not differ ($P = 0.247$) among goats fed the control, 45 g/d RB, or 90 g/d RB, while the 135 g/d RB treatment had lower ($P =0.088$) FT and LC. Muscle confirmation was greatest ($P = 0.051$) for goats fed the control and 45 g/d RB diets, with the 90 g/d RB diet being intermediate, while the 135 g/d RB diet was lowest. Animal performance varied greatly across treatments, but was consistently lower for goats receiving 90 g/d RB and 135 g/d RB, and the only occurrences of urinary calculi developed on these treatments.

Key Words: Goat, Growth, Urinary Calculi

599 The performance of Spanish kids born under mixed-species grazing system. S. Gebrelul, T. Walsh*, Y. Ghebreiyessus, V. Bachireddy, and R. Payne, *Southern University*, *Baton Rouge, LA*.

Records of 542 body weights, body condition (BCS) and FAMACHA (FS) scores were analyzed to evaluate the performances of Spanish kids born under mixed species grazing system. In a 2×#42 factorial, 40 Spanish does and 14 Brangus cows were randomly assigned to continuous (CONT) or rotational grazing (ROT) systems, and two grazing schemes, goats alone (GTA) or grazed mixed with cattle (MXD). A land area of approximately 20 ha on Bermuda grass was divided into four pastures, two 8 ha each for mixed-species grazing and two 2 ha each for goats-alone grazing. The rotational pastures were further divided, using electric fences, into four paddocks each to facilitate rotational grazing. Each paddock was grazed for 7 days and allowed to rest for approximately 21 days. Measurements on kids born during 2005 and 2006 were taken every 28 days. Body weights were analyzed using SAS's Proc MIXED procedure where grazing schemes, grazing system, months of grazing, year of birth and interactions were included as fixed and animals as random effects in the model. Chi-square analysis was used for BCS and FS. All fixed effects were significant ($P<0.05$) sources of variation. MXD kids weighed more (19.2±0.4 vs. 15.2±0.4 kg, $P<0.01$) than GTA kids. CONT kids were heavier (18.0±0.4 vs. 16.50.04 kg, $P<0.05$) than ROT kids. Body weights ranged from 7.9±0.2 in April to 21.8±0.5 kg in October. Within each month, MXD kids were heavier ($P<0.05$) than GTA kids. Significantly more GTA kids (31.5% vs. 18.5%) scored BCS of 2 or lower, while significantly more MXD kids scored (25.5% vs. 17.7%) BCS 3 or higher. Differences ($P<0.05$) in FAMACHA score of 2 were observed in GTA and MXD kids (22.2 vs. 14.4%) as well as in kids in CONT or ROT (19.6 vs. 15.7%) grazing system. Results suggested that goats could graze with cattle to efficiently utilize available forage resources under limited resources farming systems.

Key Words: FAMACHA, Goat, Mixed Grazing

600 The performance of Spanish does under mixed-species grazing system. S. Gebrelul, T. Walsh*, Y. Ghebreiyessus, V. Bachireddy, and M. Berhane, *Southern University*, *Baton Rouge, LA*.

A long-term, mixed grazing project was designed to determine the performance of goats grazing with cattle. In a 2×2 factorial, 40 Spanish goats and 14 Brangus cows were randomly assigned to continuous or rotational grazing systems, and two grazing schemes. Approximately 20 ha of Bermuda grass were divided into four pastures, two 8 ha for mixed species grazing and two 2 ha for grazing goats alone. The rotational pastures were subdivided into 4 equal sized paddocks, in which each paddock was grazed for 7 d and rested for 21 d. Goat weights, body condition scores and FAMACHA scores were collected every 28 d. Records of 1437 weights were analyzed using SAS MIXED procedure where grazing schemes, grazing systems, months of grazing and interactions were included as fixed and animals as random effects in the model. Body condition and FAMACHA scores were analyzed using Chi-square. Weights of goats grazing with cattle (36.9 ± 0.6 kg) were heavier ($P<0.01$) than goats grazed alone (34.6 ± 0.6 kg). A similar effect was noted using grazing system ($P<0.001$), where goats continuously grazing averaged 37.7 ± 0.6 kg, as compared to 33.8 ± 0.6 kg for those rotationally grazed. Significant weight differences ($P<0.01$) where observed in the interaction of grazing scheme and system with goats grazed with cattle continuously weighing more (39.9 ± 0.8 kg) as compared to the other three interactions. The majority of goats, regardless of grazing scheme or system, tended to have a body condition score between 2 and 3 on a 5 point scale. A shift in the scores was observed starting in the spring and moving toward fall, where there was an increase in those scoring 3 or better. Similar trends were observed with FAMACHA scores, with the majority of goats scoring a 2 or 3. A shift in FAMACHA scores was observed starting in the spring through the fall, with a decrease in those scoring 4 and an increase in those scoring 3. Preliminary results suggest that goats could graze together with cattle to efficiently utilize available forage resources.

Key Words: FAMACHA, Goats, Mixed Grazing

601 The effect of mixed species grazing systems on soil compaction and permeability. Y. Ghebreiyessus*, V. Bachireddy, S. Gebrelul, R. Payne, M. Berhane, and Z. Augustine, *Southern University*, *Baton Rouge, LA*.

A study to evaluate the effect of mixed species grazing systems on soil physical properties particularly soil compaction and permeability was conducted. Animals were grazed on Bermuda grass pastures during the summer and ryegrass during the winter. In a 2×2 factorial, 40 Spanish goats and 14 Brangus cows were randomly assigned to continuous or rotational grazing systems, and two grazing schemes (goats alone and goats mixed with cattle). A land area of approximately 20 ha on Bermuda grass was divided into four pastures, two-8 ha each for mixed-species grazing and two-2 ha each for goats-alone grazing. The rotational pastures were further divided, using electric fences, into four paddocks each to facilitate controlled grazing. Each paddock was grazed for 7 days and allowed to rest for approximately 21 days. Soil physical properties that determine soil compaction and permeability were collected in Fall and Spring seasons. The parameters were penetrometer reading, bulk density, soil water content and soil infiltration rate. Based on one year data significant difference in penetrometer readings was found between seasons, grazing systems, among species and grazing by specie interactions. Soils with rotational cattle grazing were more compact compared with the other treatments. Mean penetrometer readings were 4.4 ± 0.1 and 4.19 ± 0.2 revolutions for the rotational and continuous grazing, respectively. Soil compaction by goats was the lowest (3.4 ± .2 revolutions). Bulk density, which is a measure for soil compaction, was significant among species with cattle grazing 1.48 and goats 1.34 Mg/m3. Soil water content was higher (25.6 vs. 19.7, $P < 0.05$) in spring than fall, indicating more compaction in spring months. Soil permeability was significantly higher (0.45 vs. 0.13 cm/hr, $P < 0.05$) with goat grazing as compared with cattle grazing.

Key Words: Goats, Mixed Grazing, Soil Compaction

Joint National Extension Workshop: Changing the Future of Food Animal Production

602 Introduction to the symposium: The lengthening chain of change. R. E. Stup*, *The Pennsylvania State University*, *University Park*.

Extension has a rich history of helping farmers to adopt new technology and improved management practices. Throughout most of Extension's history change could be initiated by exposing farmers to information that demonstrated the benefits of the new technology or practice. Extension educators used on-farm demonstration, farmer meetings, newsletters, factsheets and many other methods to present research-based information to farmers. The farmer evaluated the concept he was presented with and made a decision about whether, when, and how to apply the change in his own farm. This method of change could be viewed as a short chain of change extending from education to implementation (i.e. extension educator presents concept to farmer who decides and implements the change). This chain of change was successful throughout much of the twentieth century and in many cases it is still successful today. In recent decades, however, farmers have expanded operations and thus increased the number of people employed. As farms grew larger, the farm owner was less likely to personally perform production operations, because other employees did that. The chain of change from education to implementation grew longer as employees were added to farms (i.e. extension educator presents concept to farmer, farmer decides whether and when to implement change, farmer trains and directs employees, employees implement change). In addition, the implementation end of the chain sometimes looks more like a web because multiple employees are involved in implementation. Obviously, this chain is much longer and more prone to breaks. The longer and more complex chain of change that we deal with today requires Extension to understand organizational change processes, not just individual education processes. This is a significant challenge and opportunity for Extension. It is a challenge because change management involves learning a new set of skills. It is an opportunity because there are few other entities in the agricultural sector that focus on organizational change. This session will introduce you to change processes and share how some Extension educators have dealt with rapidly changing industries.

Key Words: Change Management, Extension, Industry Changes

603 Adapting extension to rapidly changing industries: A pork industry experience. M. T. See*, *North Carolina State University*, *Raleigh*.

Extension programs have been delivered to the pork industry by NC State University since 1918. Over much of this period the NC pork industry experienced steady growth. However, since 1990 the NC pig crop increased four-fold from 5.1 million head to 20.1 million pigs in 2006. Today NC is recognized internationally for its large, modern and vertically integrated industry. Rapid growth was accompanied by increases in vertical integration, changing regulation, expanding workforces, and rapid technology adoption. These trends continue along with industry consolidation, internationalization, and changes in language and culture of workers. With changes of this magnitude occurring among our clientele, changes in programming offered and delivery methods were required. Local delivery of extension programs to the pork producers centers on manure management allowing county agents to specialize in an area where every producer and contract grower needs assistance. In addition, NC has state legislation requiring manure management plans and continuing education of producers. Traditional programs in nutrition, health, reproduction, genetics and management occur predominantly among peer groups including extension specialists, industry scientists and managers. Understanding the management and decision making structure of producers is required to design appropriate technology transfer methods. Our swine extension programs have a large component of production research, addressing industry needs and technology adoption. As financial resources for extension have declined our programs have grown through increased partnership with producer associations, production companies, and allied industry. We jointly offer educational programs with NC Pork Council, National Pork Board, and specific production companies on a cost-recovery basis. Electronic information transfer has become common place and allows us to reach a broad audience. Changing our extension programs as the NC pork industry has changed has allowed us to continue to provide relevant, research based information to pork producers helping them to efficiently and responsibly produce a quality product for consumers.

Key Words: Extension, Pigs, Pork

604 Adapting extension to the rapidly changing dairy industry. E. R. Jordan*, *The Texas A&M University System*, *Dallas*.

Over the last 50 years, the dairy industry has undergone dramatic changes. The number of milking cows has been cut from 21 million head on 2.9 million farms in 1955 to just over 9 million on less than 80,000 farms in 2005; thus herd size has grown from 7 cows per herd to over 110 cows. At the same time production has tripled, from less than 2700 kg of milk per cow to 8900 kg per cow. Numerous technological advances from artificial insemination to total mixed rations have been adopted by the industry to enhance productivity of the modern dairy cow. Extension educators have facilitated the transfer of these technological advances by using on-farm demonstrations, conducting producer educational meetings, and generating fact sheets and newsletters to disseminate information. Through these techniques producers progressed through the five stages of adoption for new technologies—awareness, interest, evaluation, trial and adoption. With the advent of computer technology and internet distribution of information, innovative producers are accessing information through alternative sources and implementing practices without waiting for unbiased scientific results on the benefits of a product. Extension will continue to have a role in differentiating beneficial products or practices for innovators and early adopters; however the timeline for evaluation will be accelerated. This accelerated pace of evaluation will result in the Extension professional functioning as a researcher and educator simultaneously. An increasing workforce at the non-managerial level provides another audience for Extension educators. The focus of these educational programs will be on proper techniques and explaining the importance of given procedures. To effectively reach this audience, educational programs will frequently be in a second language and written materials will be translated or an alternative medium (video or podcast) may be required for those with limited formal education. Although many techniques traditionally used to promote change can be adapted to today's clientele, it is imperative for Extension to remain relevant and that modern delivery methods be adopted.

Key Words: Extension, Delivery Methods, Technology Transfer

605 Extension's responsibility in responding to emergency and controversial issues. J. F. Ort*, *North Carolina State University*, *Raleigh*.

Extension's programs vary from state to state, but the system is united by a shared mission of helping people put research-based knowledge to work. Amid debate surrounding contentious issues such as land and water use, animal rights, and genetically modified organisms, Extension best fulfills this mission by serving as the go-to source for unbiased expertise, and by convening and facilitating informed communication among various stakeholders. Likewise, Extension has an important role to play in delivering information that helps industry and society prepare for, respond to and recover from emergencies, such as those brought about by natural disasters and disease outbreaks. Three regional conferences to be held in 2007 are designed to help government, industry and other stakeholders fully understand the capacity to which Extension can serve in animal agrosecurity, and the reasons why serving in regulatory and advocacy roles can undermine Extension's ability to achieve its important educational mission.

Key Words: Extension, Emergency Issues, Controversial Issues

606 The effect of dietary omega-3 fatty acids on adipose tissue cellularity in grower/finisher pigs. S. A. Meers*, C. R. Dove, and M. J. Azain, *University of Georgia*, *Athens*.

The objective of this study was to determine the effects of feeding a diet containing omega-3 fatty acids during grower and/or finisher phases on adipose tissue composition and cellularity. The study was designed as a 2 x 2 factorial arrangement, with main effects of feeding omega-3 fatty acids in the grower diet and/or finisher diet. Diets were corn-SBM based diets such that the grower diet (G) was calculated to contain approximately 3327 kcal/kg ME, 17.9% CP and, 1.0% lysine, while the finisher diet (F) was calculated to contain 3340 kcal/kg ME, 17.0% CP and, 0.9% lysine. Omega-3 fatty acids were supplemented in the form of 2% fish oil (Virginia Prime Gold, Omega Protein, Houston, TX) in the n-3 diets, while the Control diets had 2% soybean oil added to them. Pigs (n=92, initial bw 29.26±0.19 kg) were allocated by gender and weight to pens where Control or Omega-3 diet treatments were assigned at random. Pigs were fed the G diets for 35 d and switched to the F diets, with half of the pigs in each dietary treatment maintained on the same diet and half switched to the other diet (Control or Omega-3). Pigs were maintained on their respective diets for an additional 35 d. Pigs were weighed and feed intake recorded approximately every 2 weeks. There were no differences in ADG, ADFI, or G:F across diet treatments. A subset of pigs from the larger study were selected from each diet treatment and slaughtered at d 35 (n=4) and d 70 (n=8) to obtain ISQ, OSQ, and leaf fat, and loin muscle samples. Across treatments cell diameter and volume were 61.79±0.98 µm and 1.2 *10^5 µm/cell, respectively at d 35, as compared to 67.81±2.4 µm and 1.6 *10^5 µm /cell at d 70 ($P< 0.02$ and $P<0.02$, respectively). There was a trend ($P < 0.07$) for a decrease in average cell size in omega-3 fatty acid fed pigs. These results suggest that diets can be supplemented with omega-3 fatty acids without affecting growth performance and that omega-3 fatty acids may attenuate adipocyte filling.

Key Words: Omega-3 Fatty Acid, Cellularity, Pig

607 Effect of amino acid program (Low vs. High) and dried distiller's grains with solubles (DDGS) on finishing pig performance and carcass characteristics. R. Hinson*[1], G. Allee[1], G. Grinstead[2], B. Corrigan[2], and J Less[3], [1]*University of Missouri*, *Columbia*, [2]*Vita Plus Corp.*, *Madison, WI*, [3]*ADM Specialty Feed Ingredients*, *Decatur, IL*.

A total of 882 TR-4 x C22 barrows (initial BW = 31.9 kg) reared in a commercial research facility were allotted to one of six dietary treatments in a completely randomized block design with 7 replicate pens per treatment (21 pigs/pen). Treatments were arranged as a 2×3 factorial with the main effects of synthetic AA program (Low vs. High) and DDGS addition (0, 10, and 20%). Pigs were fed the experimental diets in a 5-phase finisher-feeding program, with Ractopamine at 5 ppm during the final 21 d phase. At market weight (127 kg BW), pigs were marketed by intact pen to Cargill Meat Solutions (Beardstown, IL) for carcass data collection. No AA×DDGS interactions were observed for growth performance or carcass traits. High levels of synthetic AA inclusion resulted in increased ($P < 0.05$) overall ADG (1.06 vs. 1.03 kg/d) and ADFI (2.93 vs. 2.85 kg/d) and heavier ($P < 0.01$) final BW (129.6 vs. 126.7 kg) and carcass weight (95.8 vs. 93.5 kg). Overall ADG (1.03 vs. 1.06 kg), ADFI (2.86 vs. 2.93 kg), final BW (127.1 vs. 130.4 kg), and carcass weight (93.9 vs. 96.3 kg) were reduced ($P < 0.01$) when DDGS was included in the diet, with no differences ($P > 0.05$) between DDGS levels. Backfat depth (20.8 vs. 19.6 mm) and $/pig received (114.27 vs. 112.21) was increased ($P < 0.01$) in the high AA pigs. The feeding of DDGS reduced the $/pig received when compared to the control diet (112.35 vs. 115.03, $P < 0.01$). The feeding of high AA levels resulted in increased performance throughout the study and increased return/pig. The feeding of DDGS reduced overall growth performance, with minimal effects on carcass traits. The decision on the use of DDGS in G-F diets is an economic decision based on the relative cost of feed ingredients, and the economic value of the reduced growth performance. Diets with aggressive use of synthetic AA and DDGS resulted in similar benefits as observed in traditional corn-SBM diets.

Key Words: Pigs, Amino Acids, Dried Distiller's Grain with Solubles

608 Effects of co-products from the ethanol industry on pig performance and carcass composition. M. R. Widmer*[1], L. M. McGinnis[1], D. M. Wulf[1], and H. H. Stein[2], [1]*South Dakota State University*, *Brookings*, [2]*University of Illinois*, *Urbana*.

An experiment was conducted to investigate pig performance and carcass composition of pigs fed diets based on distillers dried grains with solubles (DDGS), high-protein distillers dried grains (HP DDG), and corn germ. Eighty-four pigs (initial BW: 22 kg) were allotted to 7 treatments with 6 replicates per treatment and 2 pigs per pen. Diets were fed for 114 d in a 3-phase sequence. The control diet sequence was based on corn and soybean meal. Two diet sequences were formulated using 10 or 20% DDGS in each phase. Two additional diet sequences contained HP DDG in amounts sufficient to substitute 50 or 100% of the soybean meal used in the control sequence (20 and 40%, 15 and 30%, and 10 and 20% HP DDG in phase 1, 2, and 3, respectively). The last 2 diet sequences contained 5 or 10% corn germ in the diets fed in each phase. Results of the experiment showed that for the entire experiment, ADG, ADFI, G:F, and final BW were not affected by the inclusion of DDGS or HP DDG in the diet. However, final BW increased (linear, $P \leq 0.05$) and ADG tended to increase (linear, $P = 0.06$) as corn germ was included in the diet. Hot carcass weight (HCW), dressing percentage, and carcass composition were not influenced by the addition of DDGS to the diets. There was no effect of HP DDG on HCW, dressing percentage, lean meat percent, and 10^{th} rib backfat, but LM area and LM depth were reduced (linear, $P \leq 0.05$) as HP DDG was added to the diet. Hot carcass weight, dressing percent, LM area, and LM depth was not influenced by the inclusion of corn germ in the diets, but there was an increase in lean meat percent and a decrease in 10^{th} rib backfat as corn germ was included in the diets (quadratic, $P \leq 0.05$). In conclusion, DDGS and corn germ do not negatively affect pig performance or carcass composition if included in diets fed to growing-finishing pigs in amounts of up to 20 and 10%, respectively. Also, HP DDG does not affect pig performance, but may reduce LM area and LM depth if substituting all the soybean meal in the diets.

Key Words: Corn germ, DDGS, HP DDG

609 Effect of corn distiller's dried grains with solubles (DDGS) withdrawal program on growth performance and carcass yield in grow-finish pigs. A. M. Gaines, J. D. Spencer, G. I. Petersen*, N. R. Augspurger, and S. J. Kitt, *JBS United, Inc.*, *Sheridan, IN*.

The purpose of this research was to evaluate the effect of DDGS (11.8% crude fat, 27.7% CP; and 0.81% Lys, as-fed basis) withdrawal prior to marketing on growth and carcass yield in grow-finish pigs. A total of 1,117 PIC pigs (66.1 ± 1.0 kg) were allotted to one of four treatments in a randomized complete block design with 12 replicate pens/treatment. Treatments included: a corn-soybean meal diet with 0% DDGS (Trt 1) or 30% DDGS (Trt 2), or the DDGS withdrawn from the diet three (Trt 3) or six weeks (Trt 4) prior to marketing of pigs. Diets were formulated to the same standardized ileal digestible lysine and energy level (ME basis). Pigs were fed from 66 to 128 kg BW in a 3 phase program (Phase 1, 29 d; Phase 2, 21 d; and Phase 3, 20 d). At trial termination, pigs were marketed by intact pen for carcass data collection. For the overall period, there were no differences ($P > 0.30$) in ADG or ADFI among treatments. However, G/F was lower ($P < 0.02$) for pigs fed 30% DDGS compared to pigs fed 0% DDGS or the 6-week withdrawal program (0.312, 0.305, 0.307, and 0.309 kg/kg, respectively). For pigs on the 3- and 6-week DDGS withdrawal programs, G/F was similar ($P > 0.10$). Carcass weight was reduced ($P < 0.01$) for pigs fed 30% DDGS continuously; however, the withdrawal of DDGS (3 or 6 weeks) improved ($P < 0.05$) carcass weight and was similar ($P > 0.05$) to pigs fed 0% DDGS (97.8, 94.8, 96.7, and 97.5 kg, respectively). The reduction in carcass weight of pigs fed 30% DDGS was due to a reduction ($P < 0.01$) in carcass yield (77.1, 75.9, 76.5, and 77.1%, respectively). Removal of DDGS from the diet 3- or 6-weeks prior to marketing improved ($P < 0.05$) carcass yield, but only the 6-week removal fully restored yield. There were no differences in loin depth ($P < 0.46$) or percent lean ($P < 0.56$) among treatments. This research demonstrates that continuous feeding of 30% DDGS up to market weight may result in similar growth performance, but carcass yield is negatively impacted. It does appear that the withdrawal of DDGS prior to marketing may help negate this effect.

Key Words: Dried Distiller's Grains with Solubles, Swine, Growth and Carcass

610 Effects of a Pichia-expressed phytase on performance and P excretion of growing pigs. L. M. McGinnis*[1], M. R. Widmer[1], C. L. Wright[1], T. M. Parr[2], and H. H. Stein[3], [1]*South Dakota State University*, *Brookings*, [2]*Syngenta Animal Nutrition*, *Research Triangle Park, NC*, [3]*University of Illinois*, *Urbana*.

Two experiments were conducted to evaluate the effects of feeding a Pichia-expressed phytase, Quantum™ phytase (QP), to growing pigs. In Exp. 1, 60 growing pigs (initial BW: 23 kg) were allotted to 3 treatments with 2 pigs per pen and 10 pen replicates per treatment. The positive control diet (PC) was a corn-soybean meal diet containing 1.0% dicalcium phosphate and 0.20% digestible P. The negative control diet (NC) and the QP diet were similar to the PC diet with the exception that only 0.32% dicalcium phosphate was used. The QP diet contained 500 FTU/kg of phytase equivalency and the concentration of digestible P was calculated at 0.10 and 0.20% in the NC and the QP diets, respectively. The experiment lasted 42 d. Pigs fed the PC and QP diets had greater ($P \leq 0.05$) ADG (0.92 and 0.91 vs. 0.82 kg/d), G:F ratio (0.41 and 0.43 vs. 0.37 kg/kg), and final BW (62.52 and 61.15 vs. 57.67 kg) than pigs fed the NC diet. There were, however, no differences between pigs fed the PC and QP diets. In Exp. 2, nine barrows (initial BW: 22 kg) were placed in metabolism cages and allotted to three 3 x 3 Latin squares with 3 diets and 3 periods. The 3 diets were similar to the diets used in Exp. 1. Urine and feces were collected for 5 d of each period. Pigs fed the QP diet had a lower ($P \leq 0.001$) fecal P excretion (7.63 g/5d) and a greater ($P \leq 0.01$) apparent total tract digestibility (ATTD) of P (62.46%) than pigs fed the PC diet (11.57 g/5 d and 56.35%) or the NC diet (11.73 g/5d and 41.85%). Fecal Ca output was lower ($P \leq 0.001$) for pigs fed the QP diet than for pigs fed the PC or NC diets (6.48 vs. 7.62 and 9.96 g/5d). The ATTD for Ca in pigs fed the QP (76.4%) or PC (75.5%) diets were not different, but they were greater ($P \leq 0.001$) than the ATTD for NC fed pigs (66.0%). The results confirm that low-P, QP-containing diets support pig performance to the same degree as a high-P diet, but pigs fed the QP diet have a lower fecal excretion of P and Ca than pigs fed a high P diet.

Key Words: Phosphorus, Pigs, Quantum phytase

611 Effect of form of fat and NDF addition on apparent ileal and apparent total tract digestibility of fat in diets fed to growing pigs. D. Y. Kil*[1], T. E. Sauber[2], and H. H. Stein[1], [1]*University of Illinois*, *Urbana*, [2]*Pioneer Hi-Bred Intl. Inc.*, *Johnston, IA*.

An experiment was conducted to measure the effect of the concentration and form (liquid or intact) of dietary fat and the concentration of dietary NDF on the apparent ileal (AID) and apparent total tract (ATTD) digestibility of dietary fat by growing pigs. Eleven barrows (initial BW: 38.1 ± 1.2 kg) were fitted with a T-cannula in the distal ileum and allotted to an 11 × 11 Latin square design. Four diets containing 0.92% NDF and 1.3, 3.2, 5.1, or 6.9% liquid fat (LF) from corn oil were prepared. Three additional diets were formulated by adding 3.0, 6.0, and 9.0% NDF from solka floc to the diet containing 5.1% LF. The remaining 4 diets were prepared by mixing varying amounts of whole corn germ meal and defatted corn germ meal to produce diets containing 3.0, 5.3, 7.7, or 9.7% of intact fat (IF). Ileal digesta and fecal samples were collected from pigs and AID and ATTD of fat were calculated for each diet and linear and quadratic effects of the inclusion of LF, IF, and NDF were calculated. Preplanned contrasts were used to compare AID and ATTD of the 2 forms of fat and to compare AID and ATTD. The AID of fat increased (linear and quadratic, $P \leq 0.05$) as the inclusion of fat increased regardless of the form of fat (67, 82, 88, and 83% for LF and 53, 65, 71, and 70% for IF). The ATTD of fat also increased (linear and quadratic, $P \leq 0.05$) as the inclusion of fat increased regardless of the form of fat (65, 76, 88, and 86% for LF and 48, 57, 69, and 72% for IF). On average, the values for AID (80 vs. 65%) and ATTD (79 vs. 61%) were greater ($P \leq 0.01$) for LF than for IF. There was no effect of the dietary inclusion of NDF on the AID of fat, but the ATTD exhibited a quadratic relationship ($P \leq 0.05$) with increasing level of dietary NDF (88, 85, 85, and 87% for 0, 3, 6, and 9% NDF in the diet). There were no differences between AID and ATTD of fat regardless of the diets being fed. These results suggest that LF is better digested by growing pigs than IF, but the dietary concentration of NDF does not influence the AID of fat.

Key Words: Dietary Fat, Digestibility, Pigs

612 Performance and phosphorus status of growing pigs are improved by a multi-enzyme complex containing NSP-enzymes and phytase. A. V. Mori, J. Kluess*, R. Maillard, and P. A. Geraert, *Adisseo France SAS*, *Commentry, France*.

The effect of a multi-enzyme complex containing carbohydrolase and phytase activities on performance, bone mineralization and phosphorus status of growing pigs fed a corn-barley based diet was investigated. Twenty-four (initial body weight BW: 25 kg) individually penned pigs were allotted to one of three diets in a complete randomized block design during a 6-wk study: positive control PC meeting requirements (3230 kcal/kg metabolizable energy ME, 17.9 % crude protein CP, 0.22 % available phosphorus avP, 0.67 % calcium Ca); negative control NC reformulated below requirements (-80 kcal/kg ME, -0.3 units CP, -0.13 units avP, -0.08 units Ca) and NC supplemented with the enzyme complex Rovabio™ Max (NCE). Rovabio™ Max provided 1,100 visco units (equivalent to 70 AXC) of endo-β-1,4-xylanase, 100 AGL units of endo-1,3(4)- β-glucanase, and 350 RPU of 3-phytase per kg of diet. Enzyme-supplementation significantly increased BW gain in the negative control (36.1 vs 40.1 kg, P<0.05) reaching the same performance as the positive control. Feed conversion ratio tended to be improved (P=0.07). Furthermore, enzyme addition tended to improve bone ash (%) content (17.4 vs 18.7 %; P=0.06) and P content (2.9 vs 3.2 %; P=0.07) in comparison to the negative control. Weight of the metacarpus was significantly higher (19.2 vs 21.7 g; P<0.01). Plasma P concentration showed a significant improvement of 18.5 % (P<0.05) and faecal P excretion was significantly reduced by 16.9 % (1.36 vs 1.13 %; P<0.05) due to the enzyme supplementation. In conclusion, supplementation with the multi-enzyme complex Rovabio™ Max of a corn-based diet reformulated below requirements for ME, CP, P and Ca improved growth performance, P status and excretion in the growing pig. This combination of NSP-enzymes and phytase is an efficient strategy to enhance the nutritional value of swine diets.

Key Words: Phytase, NSP Enzymes, Pigs

613 Comparison of particle size analysis of ground grain with or without the use of a flow agent. R. D. Goodband*[1], W. Diederich[2], S. S. Dritz[1], M. D. Tokach[1], J. M. DeRouchey[1], and J. L. Nelssen[1], [1]*Kansas State University*, *Manhattan*, [2]*Mid-West Laboratories*, *Omaha, NE*.

According to the American Society of Biological and Agricultural Engineers' standard, particle size analysis of grain can be conducted with or without the use of a flow agent. Because two procedures can be used, particle size results can be variable, depending on whether the laboratory uses a flow agent or not. Therefore, the objective of this study was to determine if the two procedures (with or without flow agent) were similar as measured by a Method of Agreement analysis. A total of 603 ground corn samples were analyzed for particle size with or without 0.5 g of synthetic amorphous precipitated silica (Sipernat® 22-S) per 100 g of sample. Results indicated a bias between the two procedures. Particle size analysis conducted with a flow agent will result in a mean particle size that is approximately 80 µ smaller than the result from analysis without a flow agent. There was no evidence the slope (0.027) of the comparison was different than zero (P = 0.13), indicating a similar bias across the range of particle sizes tested (400 to 1000 µ), but the intercept (-80.2 µ) was highly significant (P < 0.01). The same procedures were used in comparing particle size standard deviation. Using a flow agent produced a greater particle size standard deviation value than without a flow agent. Unlike the bias for the particle size analysis, the standard deviation values showed a significant bias that changed with increasing particle size. There was strong evidence that the slope of this line (0.460) was different than zero (P<0.05), indicating that the magnitude of difference between the two procedures increased as the standard deviation of the sample increased. Results of this study indicate that there are differences in results between the two procedures. Therefore, selection of one of the two procedures as the official standard is necessary. Also, it is important to know if a flow agent was, or was not, used in the analysis when interpreting results.

Key Words: Flow Agent, Particle Size, Quality Control

614 Effects of a dry organic acid blend on growth performance and carcass parameters in growing-finishing pigs. J Zhao*[1], R. J. Harrell[1], B. R. Hinson[2], G. L. Allee[2], F. Navarro[1], and C. D. Knight[1], [1]*Novus International Inc*, *St. Louis, MO*, [2]*University of Missouri*, *Columbia*.

A total of 720 growing pigs (40.2 ± 1.1 kg BW) were used to investigate the effect of a dry organic acid blend (DOAB) (ACTIVATE® Starter DA, registered trademark of Novus International, Inc., St. Louis, MO), containing 2-hydroxy-4-(methylthio) butanoic acid calcium, benzoic acid, and fumaric acid, on growth performance and carcass parameters. Nutrient adequate non-medicated corn soybean meal diets were supplemented with DOAB at 0 (control), 0.1%, and 0.2% for 12 weeks. Pigs were blocked by sex (20-22 pigs/pen) with 10 replicate pens per treatment and 16 replicate pens for controls. All pigs received ractopamine during the last 3 weeks (5.0 ppm and 7.5 ppm for week 1, week 2 and 3, respectively), and were harvested at Tyson's Columbus Junction plant in Iowa. Average daily gain and ADFI were linearly increased with DOAB supplementation from d 0-21 (P< 0.05) and tended to be increased for the overall period (d 0-84, P < 0.09) with no differences in feed efficiency (P > 0.38). The ADG was 1.04, 1.07, and 1.07±0.01 kg/d, and ADFI was 2.61, 2.66, and 2.70±0.03 kg/d for the 0, 0.1, and 0.2% DOAB, respectively, from d 0-84. Pigs fed DOAB had heavier body weights compared to controls (linear, P < 0.05) at d 21. Pigs fed DOAB had heavier final bodyweights than controls (P < 0.05), 127.0, 130.0, and 130.2±0.9 kg for the 0, 0.1, and 0.2% DOAB, respectively. Mortality and morbidity were not different among treatments (P = 0.69). Pigs fed DOAB had 2.5 kg heavier carcass weights (linear, P < 0.05), increased grade premium by 5% (linear P < 0.05), and higher pig value by 2.8% (linear P < 0.05). No differences were observed in back fat depth, loin depth, lean percentage, or sort loss (P > 0.30). In summary, dietary DOAB increased growth performance, final BW, carcass weights, and increased grade premium and individual pig value.

Key Words: Organic Acid, Carcass, Swine

615 Dietary arginine supplementation enhances the growth performance of milk-fed piglets. Y. Kang*[1], Y. L. Yin[1], R. L. Huang[1], X. F. Kong[1], T. J. Li[1], I. Shinzato[2], S. W. Kim[3,4], and G. Y. Wu[1,4], [1]*Institute of Subtropical Agriculture, The Chinese Academy of Sciences*, *Changsha, Hunan, China*, [2]*Ajinomoto*, *Tokyo, Japan*, [3]*Texas Tech University*, *Lubbock*, [4]*Texas A&M University*, *College Station*.

This study was designed to determine the effect of dietary L-arginine (Arg) supplementation on the growth performance of milk-fed piglets. The milk replacer powder consisted of 60% dried whey, 26% dried skim milk, 6.2% a-casein, 3.6% lactose, 1.65% glucose, 1% calcium lactate, 1% dihydrocalcium phosphate, 0.1% vitamin premix, 0.2% mineral premix, 0.1% lysine, 0.1% methionine, and 0.05% antibiotic. Seventy piglets (Landrace–Yorkshire) with similar BW (2.75 ± 0.05 kg) from 14 sows (5 piglets/sow) were weaned at 7 d of age and housed individually. Piglets were assigned randomly on the basis of BW and litter origin to one of the five treatments (14 piglets/treatment; 7 males and 7 females), representing dietary supplementation with 0.0% (control), 0.2%, 0.4%, 0.6% and 0.8% Arg (on the basis of milk powder). Milk powder was dissolved in water to obtain 18% DM, and the resultant liquid milk was fed to piglets every 4 h for 14 d. On d 0, 7, and 14, the BW of piglets was measured and jugular venous blood samples were obtained for analysis of insulin and growth hormone. There were no differences in any measured parameter between male and female piglets. Feed intakes did not differ among all the groups of piglets. ADG was similar among piglets supplemented with 0.0%, 0.2% and 0.4% dietary Arg. However, dietary supplementation with 0.6% and 0.8% Arg for 14 d increased (P<0.05) the BW of piglets by 18% and 23%, respectively, as well as ADG by 41% and 53%, respectively, compared with control piglets. Additionally, dietary supplementation with 0.6% and 0.8% Arg increased (P<0.05) plasma concentrations of insulin and growth hormone by 24â€“27% in piglets on d 14. Collectively, these results indicate that Arg availability is a major factor that limits the maximum growth of milk-fed piglets.

Key Words: Arginine, Piglets, Growth Performance

616 Production of the recombinant bovine lactoferricin and its beneficial supplementation to the diet for weaned pigs. Z. R. Tang*[1], Y. M. Zhang[1,2], Y. L. Yin[1], A. F. Stewart[3], and G. Y. Wu[1,4], [1]*Institute of Subtropical Agriculture, The Chinese Academy of Sciences*, *Changsha, Hunan, China*, [2]*Gene Bridges GmbH, BioInnovation Zentrum*, *Am Tatzberg, Dresden, Germany*, [3]*BioInnovation Zentrum, Technical University of Dresden*, *Am Tatzberg, Dresden, Germany*, [4]*Texas A&M University*, *College Station*.

This study was conducted to produce a new antimicrobial polypeptide, bovine lactoferricin (44 amino acids), using the gene engineering technology and to determine its nutritional efficacy as an additive to the diet for weanling pigs. After both *cipA* and *cipB* genes in *photorhabdus luminescens* subsp. *Akhurstii* were knocked-out using the Red/ET homologue recombination technology, a mutant (the *photorhabdus luminescens* TZR) was obtained as the host bacterial strain for protein expression. The expression plasmid pBAD-CipB-BLfcin-Ampin was constructed and transformed to the host bacterial strain, which produced high levels of the recombinant bovine lactoferricin (rBLfcin) under the induction of L-arabinose. The resultant rBLfcin reached 10% of the total bacterial protein. Experiments in vitro showed that rBLfcin had a similar antimicrobial activity to bovine lactoferricin isolated from the bovine milk. A feeding trial was conducted with 60 piglets which were weaned at 21 d of age (5.42±0.59 kg), fed a corn- and soybean meal-based diet supplemented with 0 or 0.01% rBLfcin or 0.01% polymyxin sulfate (an antibiotic), and challenged with pathogenic E. coli (k88, k99, and k149); there were 20 pigs per dietary treatment. Compared with control pigs, dietary supplementation with 0.01% rBLfcin for 3 wk increased ADG by 21%, improved the gain:feed ratio by 16%, and reduced diarrhea incidence (P<0.01). Growth performance was similar between rBLfcin- and polymyxin sulfate-supplemented pigs. Our results indicate that rBLfcin is an effective alternative to a feed antibiotic for enhancing growth performance in weaned pigs.

Key Words: Bovine Lactoferricin, Recombination Technology, Weaned Piglets

617 InraPorc: A model and decision support tool for the nutrition of growing pigs and sows. J. van Milgen*, J. Noblet, M. Étienne, A. Valancogne, S. Dubois, and J. Y. Dourmad, *INRA*, *Saint Gilles, France*.

InraPorc is a model allowing the evaluation of different nutritional strategies for growing pigs and sows. The core of the model is the definition of the animal's phenotypic potential in which both the feed intake capacity and production potential are described. The latter includes body weight gain and the shape of the growth curve for growing pigs. For sows, the production potential is determined by the changes in body weight and backfat thickness (during gestation and lactation and up to the eighth litter), litter size and litter growth. Both the sow and the growing pig models are based on the premise that nutrients are transformed into body protein and body lipid that cumulate progressively into two body pools. Lactating sows may also mobilize nutrients from these body pools to support milk production. Both models operate internally using established concepts of nutrient utilization (e.g., standardized ileal digestible amino acids, ideal protein, metabolizable or net energy). The decision support tool was designed around a common feed modules and specific modules for growing pigs and sows. The feed module allows characterizing the nutritional values of feeds and includes the complete INRA-AFZ tables of feed ingredients. Using a feeding strategy (type and quantities of feed), the user can graphically evaluate the use of nutrients by the pig. This includes the utilization of energy and amino acids for the main physiological functions, identification of (potentially) limiting nutrients, and input-output balances for N, P, Ca, Cu and Zn. In addition, the user can compare different nutritional strategies (different types or quantities of feed) and evaluate the effects on animal performance. The target audience for the model and tool include professional nutritionists and educational institutions. All underlying hypotheses and model equations are freely available and the software is from Inra at a modest cost. A slightly limited version of the software is available free of charge for academic institutions.

Key Words: Nutrition, Model, Pigs

618 Differential effects of leucine on translation initiation factor activation and protein synthesis in skeletal muscle, renal and adipose tissues of neonatal pigs. J. Escobar*, H. V. Nguyen, and T. A. Davis, *USDA/ARS, Children's Nutrition Research Center, Baylor College of Medicine*, *Houston, TX*.

In adult rats, protein synthesis in skeletal muscle and adipose tissue increases in response to pharmacological doses of leucine (Leu) administered orally. In neonatal pigs, a physiological increase in plasma leucine stimulates protein synthesis in skeletal muscle without increasing hepatic protein synthesis. However, the effect of a physiological increase in plasma leucine on renal and adipose tissue on protein synthesis has not been investigated in neonates, an anabolic population highly sensitive to amino acids and insulin. Thus, 11 crossbred pigs were food-deprived for 14 h and intra-arterially infused with Leu (0 or 400 $\mu mol \bullet kg^{-1} \bullet h^{-1}$). Protein synthesis and the activation of translation initiation factors were measured after 60 min in gastrocnemius muscle, kidney, and adipose. We have previously shown that this Leu infusion protocol increases plasma Leu to levels that mimic the physiological postprandial level. The elevation in plasma Leu increased the phosphorylation of eukaryotic initiation factor (eIF) 4E binding protein-1 (4E-BP1) in gastrocnemius muscle and kidney ($P < 0.0001$) and adipose tissue ($P = 0.06$). Infusion of Leu increased ($P < 0.04$) the phosphorylation of ribosomal protein (rp) S6 kinase (S6K1) in gastrocnemius muscle and adipose tissue but not in kidney ($P = 0.21$). A concomitant increase ($P < 0.03$) in the phosphorylation of rpS6 was measured in gastrocnemius muscle and adipose tissue but not in kidney ($P = 0.12$). Fractional rates of protein synthesis were increased in gastrocnemius muscle ($P = 0.003$) but not in adipose ($P = 0.29$) or renal ($P = 0.64$) tissues. The results show that a physiological increase in plasma leucine in neonatal pigs stimulates protein synthesis in skeletal muscle in association with the activation of translation initiation factors. However, leucine does not increase protein synthesis in adipose or renal tissues despite increased activation of translation initiation factors. (NIH AR 44474 and USDA 58-6250-6-001)

Key Words: Leucine, Protein Synthesis, Translation Initiation Factor

619 Developmental expression and resveratrol regulation of the porcine lipoprotein lipase (LPL) gene. T. Z. Shan*, Y. Z. Wang, J. X. Liu, and Z. R. Xu, *Institute of Feed Science*, *Hangzhou, Zhejiang,China*.

Two experiments were conducted to evaluate the developmental expression of the porcine LPL in porcine adipose tissues and resveratrol (RES) regulation of LPL in stromal-vascular (SV) cell cultures. In experiment 1, thirty female (Duroc – Landrace – Yorkshire) pigs in five groups of six pigs each, aged at 1 d, 7, 14, 21 and 28 wk were used to study the gene expression of LPL in subcutaneous adipose tissue (SAT), peritoneal adipose tissue (PAT) and omental adipose tissue (OAT) by means of semi-quantitative RT-PCR. In experimental 2, adipose tissue from 7 d-old female (Duroc – Landrace – Yorkshire) pigs was digested and SV cells were obtained and seeded at a density of 3 – 104 cells/cm2 on six-well (35-mm) tissue culture plates in DMEM/F12 medium containing 10% fetal bovine serum (FBS). After 10 d of growing, cultures were washed free and used for three treatments (6 replicates per treatment) for 24 h. The treatments were: control group, DMEM/F12 medium +10% FBS; RES group, DMEM/F12 medium + 10% FBS + 80 Î¼M RES; insulin group, DMEM/F12 medium +10% FBS + 100nM insulin. The results showed that there were two distinct phases of changes in adipose tissue LPL mRNA level. In the first phase (from 1 d to 7 wk), LPL mRNA level significantly increased ($P < 0.01$), and this phase was characterized by a strong positive correlation between LPL mRNA level and adipose index as well as body weight. In the second phase (from 7 to 28 wk), LPL mRNA level gradually decreased, and the LPL mRNA levels were inverse correlated significantly with both the body weight and the adipose index. Body weight and adipose index increased significantly with age ($P<0.01$). The SV cell cultures results showed that supplemental RES significantly increased the LPL gene expression by 33.0% ($P<0.05$) as compared with the control and increased by 39.7% ($P<0.05$) as compared with the insulin group. There were no difference between insulin treatment and the control. These results could provide some information for practical methods of regulating and improving efficiency of lean meat production and meat production quality.

Key Words: Lipoprotein Lipase, Resveratrol, Pig

620 Effects of dried distillers grains and conjugated linoleic acid on gene expression for key enzymes in fatty acid synthesis. H. M. White*, S. S. Donkin, M. A. Latour, and S. L. Koser, *Purdue University*, *West Lafayette, IN*.

Feeding distillers dried grains with solubles (DDGS) to swine may adversely affect carcass fat quality. Commercial gilts were fed DDGS at 0, 20, or 40 percent of total ration during the last 30 days of the finisher phase. Beginning ten days prior to slaughter, one-half of each DDGS group received either 1% conjugated linoleic acid (CLA) or 1% choice white grease. At slaughter, liver was collected for RNA isolation and backfat was collected for fatty acid and mRNA analysis. Abundance of fatty acid synthase (FAS), carnitine palmitoyl transferase I (CPT-I), acetyl-CoA-carboxylase (ACC), stearoyl-CoA desaturase (SCD1), and glycerol-3-phosphate dehydrogenase (GAPDH) mRNAs were determined using Quantitative Real-Time PCR. Abundances of mRNA for lipogenic genes were normalized to GAPDH expression within each sample. Abundance of FAS, CPT-I, ACC and SCD1 mRNAs in adipose and liver samples were not different ($P > 0.05$) for DDGS and control pigs. The addition of CLA to the diets did not alter ($P > 0.05$) FAS or CPT-I but tended to decrease abundance of ACC ($P = 0.10$) and SCD1 ($P < 0.15$) mRNA levels in adipose tissue. The ratio of saturated to unsaturated fatty acids was decreased ($P < 0.05$) with DDGS (0.64, 0.57, and 0.54 ± 0.01 for 0, 20, and 40% DDGS respectively) and was increased from 0.56 to 0.61 ± 0.01 with CLA. Feeding DDGS decreased pork quality as determined by decreased ratios of saturated:unsaturated fatty acids. There was no interaction effect ($P > 0.05$) for DDGS and CLA on any of the transcripts measured or measures of pork quality. These data indicate that the effects of DDGS to reduce pork quality are not linked to changes in lipogenic gene expression. Feeding CLA leads to increased pork quality through alterations in SCD1 to increase the ratio of saturated to unsaturated

fatty acids. Furthermore, DDGS and CLA appear to act in opposing directions on pork quality yet only CLA impacts lipogenic gene expression in adipose tissue.

Key Words: Distillers Grains, Conjugated Linoleic Acid, Gene Expression

621 Effect of dietary protein fluctuations and Paylean® on performance and carcass traits of finishing pigs. M. S. Edmonds*[1] and D. H. Baker[2], [1]*Kent Feeds, Inc.*, *Muscatine, IA*, [2]*University of Illinois*, *Urbana*.

Two trials with finishing pigs were conducted to evaluate the effects of fluctuating dietary CP levels and ractopamine (Paylean®, Elanco Animal Health) on performance and carcass traits. In Trial 1, 408 finishing pigs (mixed sex) were assigned to one of four treatments. Average initial and final weights were 89 and 123 kg, respectively. Pigs on treatments 1-4 were fed 16, 11, 16 or 13% CP from wk 0 to 2, respectively. During wk 2-5, the pigs were then fed 15, 18.33, 18 or 20% CP for treatments 1-4, respectively, with treatments 3 and 4 also containing supplemental Paylean (10 mg/kg) during wk 2-5. Overall (wk 0-5), gain, gain:feed, loin depth, percentage of lean and dressing percent were improved (P≤.05) from supplemental Paylean. No significant overall (wk 0-5) treatment differences due to protein regimen occurred between treatments 1 and 3 compared with treatments 2 and 4. Trial 2 involved 172 finishing pigs (mixed sex) in two treatments. Average initial and final weights were 91 and 136 kg, respectively. The diets consisted of: 1) control (16% CP from d 0-14, 18% CP + Paylean (5 mg/kg) from d 14-24, and 18% CP + Paylean (10 mg/kg) from d 24-35); 2) extreme CP variations (ECPV = 12.5% CP from d 0-14, 20.33% CP + Paylean (5 mg/kg) from d 14-24, and 20.33% CP + Paylean (10 mg/kg) from d 24-35. During d 0-14, pigs on the ECPV treatment (12.5% CP) had reduced (P≤.05) gains (-12.8%) and poorer gain:feed ratios (-11.7%) compared with those on the control diet (16% CP). During d 14-35, however, pigs on the ECPV treatment (20.33% CP) had improved (P≤.08) gains (+5.8%) along with a 5.1% improvement in gain:feed compared with those on the control diet (18% CP). Despite the wide dietary CP fluctuations for pigs in Trial 2, performance, gain:CP intake, and carcass traits were similar for both treatments over the 35-d test period. These data suggest that pigs can exhibit compensatory responses to varying CP levels and can perform as well as pigs fed diets with more constant levels of CP.

Key Words: Protein Level, Pigs, Compensatory Growth

622 Determining the optimum dietary tryptophan to lysine ratio in 25 to 40 kg growing pigs. A. D. Quant*[1], M. D. Lindemann[1], G. L. Cromwell[1], B. J. Kerr[2], and R. L. Payne[3], [1]*University of Kentucky*, *Lexington*, [2]*USDA*, *Ames, IA*, [3]*Degussa Corporation*, *Kennesaw, GA*.

There continues to be discussion regarding the optimum dietary Trp:Lys ratio in pigs. Some of the variation in results reported in the literature may be due to whether the ratios are stated on a total or digestible amino acid basis, and whether Lys was truly below a known requirement. After determination of a SID Lys requirement for similar size pigs, a 21-d study was conducted to determine the optimum standard ileal digestible (SID) Trp:Lys ratio in growing pigs fed a corn-soybean meal diet based on growth performance and plasma urea N (PUN) concentrations. Crossbred pigs (n=120; initial BW: 25.78 ± 2.47 kg) were blocked by gender and BW and allotted to 5 treatments with 5 pigs/pen. Graded levels of crystalline Trp were added to the basal diet, which contained 0.66% SID (0.75% total) Lys, to create various Trp:Lys ratios (SID/total basis; 12.43/14.22%, 13.92/15.54%, 15.42/16.86%, 16.92/18.18%, and 18.42/19.50%). Pigs were allowed ad-libitum access to feed and water throughout the entire experimental period. Following evaluation of the linear and quadratic nature of the responses by ANOVA, broken-line regression analysis was used to determine the optimum Trp:Lys ratio. As the SID Trp:Lys increased from 12.43% to 18.42%, ADG increased (0.56, 0.65, 0.79, 0.79, and 0.81 kg/d) linearly ($P < 0.001$) and quadratically ($P = 0.009$) with an optimum SID Trp:Lys ratio estimate for ADG of 15.70% ($P < 0.001$). ADFI increased (1.31, 1.46, 1.73, 1.67, and 1.73 kg/d) linearly ($P < 0.001$) and quadratically ($P = 0.007$) with an optimum SID Trp:Lys ratio of 15.50% ($P < 0.001$). Feed:gain decreased (2.34, 2.27, 2.19, 2.16, and 2.13 kg/d) linearly ($P < 0.001$) but not quadratically ($P = 0.36$). PUN decreased (10.43, 9.30, 8.21, 8.55, and 9.25 mg/dL) linearly ($P = 0.069$) and quadratically ($P = 0.015$) and the optimum SID Trp:Lys ratio was 15.64% ($P = 0.007$). The overall optimum SID Trp:Lys ratio was determined as 15.61% based on the mean of the estimates for growth performance and PUN concentrations which equates to 17.02% on a total amino acid basis.

Key Words: Lysine, Tryptophan, Pigs

623 Tryptophan improves weight gain associated with increased plasma ghrelin level induced by oral ingestion of tryptophan in weaned pigs. J. Yin*, H. Zhang, and D. Li, *China Agricultural University*, *Beijing, China*.

Two experiments were conducted to determine whether ghrelin, a 28-amino acid peptide produced mainly by the stomach, was involved in tryptophan-mediated growth stimulation in swine. In experiment one, 48 crossbred barrows (8.23±0.13 kg) were housed individually and randomly allotted to 6 treatments with a 2×3 factorial design to test the effects of food intake (ad lib vs. limit fed) and tryptophan level (0.12, 0.19 and 0.26%) on growth performance. At the end of the 21-day experiment, plasma was sampled and insulin and acylated ghrelin were assayed using commercial available kits. Ad lib fed pigs gained more weight, but had poorer feed conversion than limit fed pigs. Weight gain, food intake and feed conversion all improved with increased dietary tryptophan. In limited fed groups, pigs pair-fed the same amount of feed whose weight gain was improved by 0.19 and 0.26% tryptophan diet relative to 0.12% tryptophan diet. Ad lib feeding increased plasma insulin. However, plasma insulin was unaffected by the level of dietary tryptophan. Plasma ghrelin levels and ghrelin mRNA level in gastric fundus and duodenum were significantly higher in pigs fed 0.19 and 0.26% tryptophan diet compared with pigs fed 0.12%. In the second experiment, 18 weaned crossbred barrows were divided into three treatments involving oral infusion of saline, tryptophan (40 mg/kg BW) or 5-Hydroxytryptophan (40 mg/kg BW). After 7-day interval, pigs were subjected to jugular vein infusion of the same amount of saline, tryptophan or 5-hydroxytryptophan. Plasma ghrelin levels at 20, 40 and 60 min after treatment were increased by oral ingestion rather than vein infusion of tryptophan. Oral ingestion of tryptophan increased food intake 2, 8, and 24 hrs after ingestion.

Both oral ingestion and jugular vein infusion of 5-hydroxytryptophan induced lower food intake than the saline control. In conclusion, tryptophan increased weight gain and food intake may be induced by raised plasma ghrelin which triggered by oral ingestion rather than jugular vein infusion of tryptophan.

Key Words: Tryptophan, Ghrelin, Growth

624 Nitrogen balance, ammonia and odor emissions in growing pigs fed reduced crude protein diets. D. V. Braña*[1,2], H. A. Rachuonyo[1], and M. Ellis[1], [1]*University of Illinois*, *Urbana*, [2]*INIFAP*, *Queretaro, Mexico*.

The effect of reducing dietary CP level in the diet of growing pigs (20.5 ±1.8 kg) was evaluated in two experiments. The treatments consisted of 2 diets formulated to contain either a normal or a reduced CP level (19 or 14%), where the true ileal digestible lysine (0.85%), energy level (3.33 Mcal ME/kg), and ideal AA patterns (Lys, Thr, Met, and Trp) were kept constant. Study 1 was conducted to measure the amount of nitrogen loss as aerial ammonia and odor offensiveness in the air from pigs (n=24; from 17.9 ±0.76 to 30.5 ±1.02 kg of BW) confined in dynamic airflow chambers for 21 days. Study 2 was carried out using the same diets, to evaluate the impact on N balance from pigs (n=24; from 17.7 ±1.29 to 21.4 ±1.72) confined individually in metabolic crates. In Study 1, reducing dietary CP did not affect ($P > 0.05$) growth performance, but tended to decrease the slurry pH ($P = 0.09$) from 6.7 to 6.2 ±0.18. There was an interaction ($P < 0.001$) between diet and sampling day; initial ammonia levels were similar ($P > 0.1$) for the two dietary treatments, however, after 10 d on the study ammonia levels were lower ($P < 0.001$) for the reduced crude protein diet. Odor analyses from samples taken on d 14 and 21, assessed by olfactometry with an 8-member panel, did not differ by treatment (511.7 and 540.0 ±115.58 odor threshold, respectively, for the reduced and normal CP diets; $P > 0.2$), but did differ ($P < 0.01$) by sampling day, as the odor intensity in both diets increased with time (440.1 and 611.6 ±111.29 threshold values at day 14 and 21, respectively). For Study 2, N intake was reduced 26.6% ($P < 0.001$) by the reduced CP diet. Fecal N excretion was similar ($P > 0.2$) for both diets, however, urinary N excretion differed ($P < 0.001$). Reducing CP decreased ($P<0.001$) urinary N excretion by 56% and total N excretion by 41%. Overall, every one percentage unit reduction in CP (combined with AA supplementation) lowered total N losses (fecal + urinary) by 8% and ammonia production by 15%, but did not change odor intensity.

Key Words: Ammonia, Odor, Nitrogen Balance

625 Performance of pigs fed diets supplemented with DL-Methionine or liquid MHA-FA from 6 - 25 kg. O. S. Santos*[1], A. B. Borbolla[1], A. P. Pineda[1], R. F. Flores[1], A. P.-S. Pineli-Savedra[2], and D. H. Hoehler[3], [1]*Universidad Nacional Autónoma de México*, *Mexico City, Mexico*, [2]*CIAD*, *Hermosillo, Sonora, Mexico*, [3]*Degussa Corporation*, *Kennesaw, GA*.

One hundred and fifty weaned pigs (6.3 ± 1.3 Kg) were randomly allocated into five different treatments consisting of a control diet, and two sources (DL–Met or liquid methionine hydroxy analog MHA-FA), with two levels each of methionine. Pigs were fed a phase 1 (6–8 Kg), phase 2 (8–12 kg) and a phase 3 diet (12 – 25 kg). Lysine (%) and ME (Mcal/kg) of phase 1, 2 and 3 diets were 1.64/3.4; 1.42/3.4 and 1.28/3.3, respectively. Graded levels of DL–Met (treatments 2 and 3) and liquid MHA–FA (treatments 4 and 5) were supplemented at 65/100% corresponding weight/weight ratios. Feeding period was 8 days each for phases 1 and 2, and 20 days for phase 3. Data were subjected to GLM and LSM procedures of SAS. In phase 1, ADG was lowest ($P \leq 0.05$) for control pigs with no significant differences among the other treatment groups (212, 303, 285, 297 and 254 g/d for Trt 1, 2, 3, 4 and 5). ADFI was not different in any treatment evaluated (367, 392, 372, 383 and 367 g/d, for Trt 1, 2, 3, 4 and 5). FC was higher ($P \leq 0.05$) for control, with no difference in the other treatments (1.7, 1.3, 1.3, 1.3, 1.5 for Trt 1, 2, 3, 4, and 5). In phase 2, ADG was not different among Met-included groups, however, control pigs showed a reduced ($P = 0.08$) gain (430, 507, 508, 493 and 512 g/d for Trt 1, 2, 3, 4 and 5). ADFI was not affected by either source or level of Met (695, 728, 740, 732, and 747 g/d for Trt 1, 2, 3, 4 and 5). No differences were detected among the sources or levels of Met (1.6, 1.5, 1.5, 1.5 and 1.5 for Trt 1, 2, 3 , 4 and 5). In phase 3 –in contrast to previous phases– ADG was not different between control and treatment groups (562, 585, 577, 578 and 560 g/d for Trt 1, 2, 3, 4 and 5). ADFI increased ($P \leq 0.05$) when Met was included in treatment 2 and 4, as compared to control pigs (1038 and 1030 vs. 955 g/d, respectively). Trt 3 and 5 was not different to control. FC was not significantly influenced by either treatment (1.7, 1.8, 1.7, 1.8, 1.8 for Trt 1, 2, 3, 4 and 5).

Key Words: DL-Methionine, Pigs, MHA-FA

626 Low protein diets for pigs treated with ractopamine. G. E. Lanz A*[3,1] and J. A. Cuaron I[2], [1]*Paiepeme A.C.*, *Queretaro, Mexico*, [2]*CNI-Fisiologia Animal, INIFAP*, *Queretaro, Mexico*, [3]*FESC UNAM*, *Ajuchitlan, Queretaro, Mexico*.

The aim of this experiment was to demonstrate that RAC may be used with diets containing less than 16% crude protein (CP), as long as a 0.82% level of true ileal digestible lysine (LysD) is kept and the relation with the other limiting amino acids is maintained, obtaining favorable results for lean tissue gain. A total of 40 barrows were used with an initial weight of 80 ± 8.95 kg. Animals were allotted to 4 treatments 1) Positive Control: 16% CP + 0.60% LysD; 2) Negative Control: 14% CP + 0.60% LysD; 3) RAC normal protein: 16% CP + 0.82% LysD + RAC; 4) RAC lower protein: 14% CP + 0.82% LysD + RAC, each with 10 replicates per treatment. The RAC dosage was 5 ppm for the first 14 days and 10 ppm for the last 7 days. Levels of LysD were established as the population's requirement and according to the expected response of lean growth by RAC. According to LysD, limiting amino acids were included in concentrations sufficient to meet an Ideal Protein pattern, for control pigs, and adjusting the Threonine:Lysine ratio to 64% for pigs treated with RAC. Pigs were weighed every 7 days until the end of the experiment. Daily feed intake (DFI), daily bodyweight gain (DBG), feed efficiency (GxF), and daily lean tissue gain (DLTG), were estimated. Animals were humanly sacrificed to estimate carcass and industrial lean cuts yield. There were no differences by protein level and there were no interactions between RAC and protein level ($P \geq 0.05$). The RAC effects were clear, despite the protein level in diet. In both treatments with RAC, body weight gain (ADG), was improved by 11%; feed efficiency was improved by 15%, and FFLG was improved by 39%, compared to pigs not fed RAC. Also RAC improved carcass yield (head and feet on) by more than 1 percent unit; RAC augmented carcass lean cuts by more than

4 kg. Since there were no differences between treatments with RAC, but there were differences with those that did not contain RAC, we conclude that it is possible to use RAC with diets containing less than 16% CP.

Key Words: Ractopamine, Lean Tissue Gain, Carcass Yield

627 Effects of ractopamine level and feeding duration on the performance and carcass characteristics of late finishing market pigs. C. W. Parks*[1], G. L. Allee[2], R. B. Hinson[2], and S. N. Carr[1], [1]*Elanco Animal Health*, *Greenfield, IN*, [2]*University of Missouri*, *Columbia*.

A study was conducted to evaluate the effects of Ractopamine HCl (RAC; Elanco Animal Health, Greenfield, IN) on the performance and carcass characteristics of late-finishing pigs. A total of 1,680 pigs w/ an average BW of 101 kg were used in a 3x2x2 factorial design consisting of 3 RAC levels (0, 5, and 7.4 ppm RAC), 2 RAC feeding durations (21 or 28 d prior to slaughter), and 2 genders (barrows and gilts). Diets were corn-soybean meal based and were formulated to contain 0.94% TID lysine. There were no dose x duration, nor gender x dose interactions; therefore, main effects of dose are presented. Pigs fed 5 and 7.4 ppm RAC had greater ADG (P<0.0001) and G:F compared to controls (P<0.0001). In addition, pigs fed 7.4 ppm had improved ADG (P<0.0001) and G:F (P<0.0001) as compared to pigs fed 5 ppm RAC. Feed intake was unaffected by treatment (P<0.14). Carcass data indicated an increase in HCW (P<0.0001) and yield (P<0.03) in RAC-fed pigs compared to control pigs. There were no differences observed in back fat depth due to treatment (P<0.18). However, there was an increase in LM depth due to both RAC treatments compared to controls (P<0.0001), as well as a significant improvement in lean percentage when feeding 5 ppm RAC compared to controls (P<0.05). These results indicate that RAC at 5 and 7.4 ppm improve the growth performance and carcass characteristics of late-finishing pigs.

Effects of ractopamine dose on performance and carcass characteristics

Measurement	0 ppm RAC	5 ppm RAC	7.4 ppm RAC	SEM
ADG, kg	0.76[a]	0.85[b]	0.91[c]	0.010
ADFI, kg	2.57	2.56	2.60	0.017
G:F	0.30[a]	0.33[b]	0.35[c]	0.003
HCW, kg	89.7[a]	92.2[b]	93.6[c]	0.405
Yield, %	74.8[a]	75.6[b]	75.7[b]	0.260
LM depth, mm	56.1[a]	57.6[b]	58.8[b]	0.340
Backfat depth, mm	17.6	17.0	17.5	0.260
Lean, %	52.9[a]	53.3[b]	53.2[ab]	0.130

[a,b,c] Means differ (P<0.05)

Key Words: Ractopamine, Growth, Pigs

628 The effect of dietary lysine or methionine and copper/manganese on osteochondrosis lesions and cartilage properties in pigs. N. F. Frantz*, J. L. Nelssen, G. A. Andrews, M. D. Tokach, S. S. Dritz, R. D. Goodband, and J. M. DeRouchey, *Kansas State University*, *Manhattan*.

An 84-d growth study with 120 gilts (initially 40.5 kg BW, 10 replications with 2 gilts per pen) was conducted to determine the influence of dietary lysine level and added methionine, copper, and manganese on osteochondrosis (OCD) occurrence in swine. Gilts were fed below (0.71% phase I and 0.53% phase II), at (0.89% phase I and 0.71% phase II), or above (1.16% phase I and 0.98% phase II) their requirement for true ileal digestible lysine (Lys) with standard concentrations or high added methionine (1%), Cu (250 ppm) and Mn (220 ppm) in a 3 × 2 factorial. At the end of the experiment, the distal aspect of the left humerus and femur of 60 gilts (one per pen) was evaluated for incidence of OCD and cartilage samples tested for compression and shear properties. Each joint was sliced into 3 mm sections and given a severity score for abnormalities on the external joint, the underlying articular cartilage surfaces, and physeal growth plate. Increasing dietary Lys increased (P < 0.01) ADG, but feeding high Met/Cu/Mn decreased ADG (P < 0.02). In pigs fed standard Met/Cu/Mn, increasing dietary Lys decreased cartilage shear energy (quadratic, P < 0.01); however, no other instron measurements were affected by Lys (P > 0.24). The addition of high Met/Cu/Mn had no effect on any cartilage instron measurements (P > 0.23). All animals had OC lesions at either the humerus or femur. Overall severity score did not correlate with ADG (R2 = 0.03) or weight (R2 = 0.02). Increasing dietary Lys concentration (P > 0.64) did not effect the overall severity score (abnormalities × severity); however, the addition of high Met/Cu/Mn tended (P < 0.09) to reduce the overall severity score of OC compared to pigs fed diets with normal Met/Cu/Mn. Feeding growing gilts to maximize growth performance with high dietary Lys may increase the severity of OC lesions, while a diet with additional Met/Cu/Mn above requirements may aid in the reduction of OC abnormalities and severity.

Key Words: Finishing Pigs, Osteochondrosis, Cartilage

629 Effects of different Ractopamine withdrawal times on growth performance and fat free lean growth rate in finishing pigs. G. E. Lanz A*[3,1], M. Lucero P[3,1], and J. A. Cuaron I[2], [1]*Paiepeme A.C.*, *Queretaro, Mexico*, [2]*CNI-Fisiología Animal, INIFAP*, *Queretaro, Mexico*, [3]*FESC UNAM*, *Ajuchitlan, Queretaro, Mexico*.

Some programs for the use of Ractopamine–HCl (RAC) include resting periods to avoid receptors saturation. To identify the effects of RAC withdrawal on growth performance and fat free lean growth rate in finishing pigs, 159 pigs (BW = 82 kg) half gilts and barrows, were allotted to 3 diets: 1) Control: 3.35 Mcal ME and 17%CP; 2) RACHP: 3.35 Mcal, 19%PC, 10ppm RAC; 3)RACNP: as control plus 10 ppm RAC. After 21d on trial, all the animals changed to a finisher diet (3.35 Mcal ME/kg, 15%CP, 0.67% digestible Lys) consumed by 0, 7, 14, 21 or 28 d. After each withdrawal time animals were removed from the experiment (5 animals per withdrawal time per diet). Growth performance (ADFI, ADG, and Feed:Gain), and real time ultrasound (Aloka 500) measurements (back fat and loin depth) were taken weekly to estimate lean growth rate. After 21d on Study, RAC pigs were heavier (P≤0.001) than CON pigs; animals on RACNP consumed more feed than RACHP (3.23 vs 3.07 kg/day, respectively, P≤0.05). There was no difference in ADG or Feed:Gain by CP level, but between RAC and CON pigs (P≤0.001). The RAC diets improved FFLG (0.352 vs 0.430 kg/day P≤0.001) compared to CON pigs, but no differences

(P≥0.05) by CP level were detected. After 7 d of RAC withdrawal, ADG was depressed (P≤0.01) compared to CON pigs (0.650 vs 0.836 kg/day, respectively). However, no differences (P≥0.05) were detected at any time during RAC withdrawal for ADFI, F:G back fat or loin depth, as RAC pigs equal CON pigs' growth performance after day 7. The drop in ADG (after 7d) that resulted from RAC withdrawal, denied the advantages of RAC use, this should be considered in use–rest–use programs to establish a resting period no longer than 7 days.

Key Words: Ractopamine, Withdrawal, Finishing Pigs

Nonruminant Nutrition: Understanding Protein Synthesis and Degradation and Their Pathway Regulations

630 Postnatal ontogeny of skeletal muscle protein synthesis in pigs. T. A. Davis*, A. Suryawan, R. A. Orellana, and M. L. Fiorotto, *USDA/ARS Children's Nutrition Research Center, Baylor College of Medicine*, *Houston, TX*.

The neonatal period is characterized by rapid growth and elevated rates of synthesis and accretion of skeletal muscle proteins. The fractional rate of muscle protein synthesis is very high at birth and declines rapidly with development. The elevated capacity for muscle protein synthesis in the neonatal pig is driven by the high ribosome content and, together with an increased efficiency of the translation process, promotes accelerated protein synthesis rates. Feeding profoundly stimulates muscle protein synthesis in neonatal pigs and the response decreases with age. The feeding-induced stimulation of muscle protein synthesis is modulated by an enhanced sensitivity to the post-prandial rise in insulin and amino acids. The developmental decline in the response to insulin and amino acids parallels a marked fall in the feeding-induced activation of translation initiation factors that regulate the binding of mRNA to the 40S ribosomal complex. The abundance and activation of many known positive regulators of the nutrient- and insulin-signaling pathways that are involved in translation initiation are high and that for many negative regulators are low in skeletal muscle of younger pigs. Thus, the activation and/or abundance of the positive regulators, insulin receptor, insulin receptor-substrate-1, phosphoinositide-3 kinase, phosphoinositide-dependent kinase-1, protein kinase B, mammalian target of rapamycin, raptor, ribosomal protein S6 kinase-1, eukaryotic initiation factor (eIF) 4E-binding protein 1, and eIF4E associated with eIF4G are greater in 7- than in 26-day-old pigs. The activation of negative regulators, protein tyrosine phosphatase-1B, PTEN, protein phosphatase 2A, and tuberous sclerosis complex 1/2 are lower in 7- than in 26-day-old pigs. The developmental changes in the abundance and activation of these signaling components likely contribute to the high rate of protein synthesis and rapid gain in skeletal muscle mass in neonates. (NIH AR44474, USDA NRI 2005-35206-15273, USDA CRIS 58-6250-6-001)

Key Words: Swine, Protein Synthesis, Muscle

631 Measuring in vivo intracellular protein degradation rates in animal systems. W. G. Bergen*, *Auburn University*, *Auburn, AL*.

Whole body protein degradation, synthesis and accretion have been determined in animals utilizing isotopic tracers and urinary excretion of irreversible skeletal muscle metabolic end-products combined with various techniques to estimate changes in body protein content. Method refinements have centered on improvements of whole body isotope-kinetic approaches and explorations of tissue specific protein turnover of liver, small intestines and skeletal muscle proteins or specifically myofibrillar, sarcoplasmic, and connective tissue protein fractions of skeletal muscles. Utilizing contemporary GC-MS technology and isotopic infusion strategies, direct measurement of fractional protein synthesis (FSR) with stable isotopes of branched chain amino acids coupled with tissue amino acid specific activity values based on keto leucine or keto valine has emerged as the most robust technique to measure FSR in various tissues in animals and humans. Direct measures of whole body protein degradation or fractional breakdown rate (FBR) based on skeletal muscle irreversible metabolite excretion, such as 3- methyl histidine (3MH), in pigs has severe limitations. Some workers have addressed direct measures of skeletal muscle protein breakdown in pigs utilizing 3MH with compartmental kinetic models, but regrettably such procedures have not widely utilized. Contrariwise, the urinary 3MH excretion method has some merit in ruminants. Our understanding of the mechanisms and regulation of protein synthesis and protein breakdown has advanced to a point where it may be possible to use surrogates/markers to provide directional data, either enhanced or attenuated, for FSR and FBR. Rates of expression or activation status of regulatory transcription factors, initiation factors or signal pathway components, such as mTOR, eIF-4 and PKB, and abundance of mRNA for components of the intracellular proteolytic pathways may be exploited to study relative rates of FSR, FBR, muscle growth and metabolic efficiency in food producing animals.

Key Words: Protein Turnover, Isotope Kinetics, Proteasome

632 The non-lysosomal Ca^{2+}-dependent protein degradation pathway: The calpains, proteasome, and myofibrillar protein turnover. D. E. Goll*, G. Neti, S. W. Mares, and V. F. Thompson, *University of Arizona*, *Tucson*.

It is now clear that proteins in cells turnover metabolically, that the rate of this turnover can vary widely in response to physiological demand, and that turnover of proteins assembled in intracellular structures requires first disassembly of the proteins from the structure followed by their degradation. The proteasome is the major mediator of intracellular protein degradation, but the proteasome cannot degrade proteins assembled in intracellular structures, and the mechanism by which proteins are disassembled before their degradation remains unknown for most structures. It is also unclear how myofibrillar proteins, which must be assembled in myofibrils to be functionally contractile, are removed from this structure before degradation. It was proposed over 30 years ago that the calpains may initiate myofibrillar protein turnover by removing an outer layer of filaments from myofibrils, and that the calpain-removed proteins are then degraded by intercellular proteases, predominantly the proteasome. Studies have reported that striated muscle contains a group of myofilaments, ~ 10-15% of total myofibrillar protein, that can be released from myofibrils by triturating in the presence of ATP. These easily releasable myofilaments (ERMs)

are postulated to be intermediates in myofibrillar turnover. It is unclear whether ERMs are indeed a subset of myofilaments on the surface of myofibrils or whether they are simply removed by shearing during trituration and more filaments can be removed by repeated trituration. We have found that ERMs can be prepared from either rat or bovine muscle; that the yield is less than previously reported (0.5-0.8 % of myofibrillar protein); that once removed, repeated trituration does not yield more ERMs; and that ERMs can not be obtained from thoroughly washed myofibrils where presumably the ERMs have already been removed. Hence, ERMs seem to be a real subset of filaments. Mild treatment with calpain increases the yield of ERMs by 2 to 2.5-fold, so the calpains can release ERMs as proposed over 30 years ago. Supported by NRI, NIH, MDA.

Key Words: Calpain, Proteasome, Myofibrillar Protein

633 The mTOR-signaling pathway in regulating metabolism and growth. X. Yang*, C. Yang, A. Farberman, C. F. M. de Lange, J. France, and M. Z. Fan, *University of Guelph*, *Guelph, Ontario, Canada*.

The mammalian target of rapamycin (mTOR) plays key roles in cell growth and the cell cycle and acts as a central regulator of protein synthesis and ribosome biogenesis at transcriptional and translational levels. mTOR senses and integrates signals from mitogens and nutrients. Ribosomal protein S6 protein kinase S6K1 and eukaryotic initiation factor 4E binding protein 4E-BP1 are currently the two best-known downstream effectors of mTOR signaling. Interactions of mTOR with raptor or rictor result in two types of mTOR complexes with the former being the primary controller of cell growth and the latter mediating effects that are insensitive to rapamycin such as cytoskeletal organization. Upstream elements of mTOR signaling include Ras-homolog enriched in brain (Rheb), and tuberous sclerosis complex 1 and 2 (TSC1/2) with TSC2 as the linker between PI3K/Akt or Ras/Raf/MEK/ERK pathways and the mTOR pathway. AMP activated kinase (AMPK), an important cellular energy sensor, can work with mTOR signalling to maintain cellular energy homeostasis. Nutrients and hormonal factors can differentially mediate metabolism and cellular growth via the mTOR pathway with effectors specific to organ or tissue types involved.

Key Words: Growth, Metabolism, Mammalian Target of Rapamycin (mTOR)

Physiology & Endocrinology - Livestock and Poultry: Endocrinology

634 Relationship between leptin and carcass quality and yield grade in a population of Certified Angus Beef–type cattle. D. L. McNamara*[1], T. B. Schmidt[3], E. L. Walker[4], M. M. Rolf[1], A. N. Brauch[1], W. Pittroff[2], and D. H. Keisler[1], [1]*University of Missouri*, *Columbia*, [2]*University of California*, *Davis*, [3]*Mississippi State University*, *Starkville*, [4]*Missouri State University*, *Springfield*.

Leptin is a protein hormone secreted by adipocytes. Serum concentrations of leptin increase with adiposity in various species, including beef cattle. In this investigation, we utilized a relatively uniform population of cattle — i.e. those destined for a Certified Angus Beef–type market, to determine the relationship between serum concentrations of leptin and phenotypic variables associated with carcass quality. This work differs from our prior investigations in which we utilized a non–uniform and random population of cattle from a commercial slaughter facility. Our hypothesis was that serum concentrations of leptin would be higher in heifers than steers and that serum concentrations of leptin would be an accurate, positive indicator of carcass quality and yield grades in a Certified Angus Beef–type population of cattle. In the current investigation blood samples were collected at slaughter and analyzed for serum concentrations of leptin from 2,815 black slaughter steers and heifers. The PROC GLM method of SAS was used with leptin as the dependent variable and all carcass merit variables analyzed as independent variables within the model. Any independent variables that were not significant within the model were removed from the final analysis. We observed that leptin levels were significantly greater in heifers than steers (25.12 vs 20.94 ng/ml, respectively; $P < 0.0001$). Independent of gender however, leptin concentration at the time of slaughter was a significant predicative indicator of the carcass quality grades: select, low choice, upper two-thirds choice, high choice, and prime (20.60, 22.16, 23.38, and 25.99 ng/ml, respectively; $P < 0.006$). Likewise, USDA Yield grades were resolvable by leptin levels at Yield grades 2, 3, and 4 (20.95, 23.32, and 25.74, respectively; $P < 0.001$), but incapable of resolving Yield grade 4 vs. 5 cattle — a threshold point (yield grade >3) at which carcasses typically begin to be discounted for excessive fat. We suggest that these data provide evidence that serum concentrations of leptin are indicative of the greater fat mass across gender and carcass merit.

Key Words: Leptin, Adipose, Carcass

635 Variation in maintenance energy requirements of gestating beef cows and relationships with calf performance and plasma IGF-I. M. J. Prado-Cooper*, N. M. Long, R. P. Wettemann, G. W. Horn, L. J. Spicer, and C. R. Krehbiel, *Oklahoma Agricultural Experiment Station*.

Variation in maintenance energy requirements (MR) was determined in spring-calving Angus × Hereford cows during gestation in each of two years (yr 1, n = 27; yr 2, n = 32). A second objective was to determine if MR were related to plasma concentrations of IGF-I and postnatal calf growth. Nonlactating cows (4 to 7 yr of age) with a BCS of 5.0 ± 0.2, and BW of 582 ± 37 kg, in the second to third trimester of gestation, were individually fed a complete diet in amounts to meet predicted MR (Model 1, NRC 2000). After 2 wk, daily feed intake was adjusted each 7 d until constant BW was achieved. Regression analysis was used to determine constant BW. Final BCS averaged 5.0 ± 0.2 (yr 1) and 4.6 ± 0.4 (yr 2). Daily MR averaged 0.0892 (yr 1) and 0.0930 (yr 2) (Mcal/$BW_{kg}^{.75}$). Cows were classified based on MR as low (> 0.5 SD less than mean, L), moderate (± 0.5 SD of mean, M) or high (> 0.5 SD more than mean, H). The greatest differences in MR for all cows were 29% (yr 1) and 24% (yr 2). ADG and IGF-I were

analyzed using the GLM and MIXED procedures (SAS), respectively. In yr 1, 205 d BW of calves (200 kg) was not influenced by MR. Plasma concentrations of IGF-I (yr 2), after consuming NRC predicted MR, were greater ($P < 0.005$) for M cows (66.5 ± 4.8 ng/mL) compared with L cows (38.9 ± 5.7 ng/mL), and H cows (52.8 ± 4.8 ng/mL) were not different from M or L cows. After 3 wk of constant BW, concentrations of IGF-I were not different ($P = 0.14$) among L, M and H cows (40.2, 52.1 and 51.2 ± 4.4 ng/mL, respectively). Concentrations of IGF-I in plasma were not correlated with dietary intake (Mcal/d) or BW. With ad libitum intake (yr 2), ADG of the cows was influenced by MR; L cows had less ($P < 0.01$) ADG compared with M and H cows (1.0, 1.4, 1.6, ± 0.3 kg/d, respectively). Variation in MR of cows during gestation was not associated with performance of calves. Identification of cows that require less energy to maintain weight may increase efficiency of production.

Key Words: Maintenance, Beef Cattle, Calves

636 Negative energy balance increases prandial ghrelin and growth hormone concentrations in lactating dairy cows. B. J. Bradford* and M. S. Allen, *Michigan State University*, *East Lansing*.

The reported effects of feeding on growth hormone (GH) secretion in ruminants have been inconsistent, and may be influenced by energy status of animals. High-producing dairy cows in early lactation and late lactation were used to assess the effects of energy balance on temporal variation of plasma metabolites and hormones. Cows were fed a TMR once daily, and feed was withdrawn for 90 min prior to feeding. Beginning at the time of feed withdrawal, plasma samples were collected via jugular catheters hourly for 24 h. Concentrations of non-esterified fatty acids and GH were measured for all samples, while insulin, glucose, and acylated (active) ghrelin were quantified for 4 sample times around feeding. Blood plasma data was analyzed using a mixed model with repeated measures over time. As expected, calculated energy balance was significantly lower in early lactation than late lactation cows (-10.4 vs. 1.7 Mcal retained /d, $P < 0.001$). Following the primary meal of the day, a GH surge was observed in early lactation but not in late lactation cows (time × stage of lactation interaction: $P < 0.01$). This difference was not explained by temporal patterns in non-esterified fatty acid, insulin, or glucose concentrations. However, a preprandial ghrelin surge was observed in early lactation only (76.8 vs. 40.1 pg/mL, $P < 0.05$), suggesting that ghrelin was responsible for the prandial GH surge in this group. Results of a stepwise regression statistical analysis showed that both preprandial ghrelin concentration and energy balance were significant predictors of prandial GH increase over baseline. Adaptations to negative energy balance in lactating dairy cattle likely include enhanced ghrelin secretion and greater GH response to ghrelin.

Key Words: Fhrelin, Growth Hormone, Energy Balance

637 Effect of ghrelin and obestatin infusion on milk production, body condition score, and energy balance in dairy cows. J. R. Roche*[1,2], A. J. Sheahan[1], L. M. Chagas[1], D. Blache[3], D. P. Berry[4], and J. K. Kay[1], [1]*Dexcel*, *New Zealand*, [2]*University of Tasmania*, *Australia*, [3]*University of Western Australia*, *Australia*, [4]*Teagasc Moorepark*, *Ireland*.

Ghrelin is an endogenous ligand of the growth hormone secretagogue receptor and a potential orexigenic agent in monogastrics and ruminants. Obestatin has been reported to have the opposite effect, reducing appetite. Fifty one multiparous cows were randomly allocated to one of three groups (n=17 cows/treatment); a control (C) and cows continuously infused with either 0.74 μmol/d of ghrelin (G) or obestatin (O) subcutaneously. Infusions began 20 days in milk and treatments continued for 8 wk. Milk yield was recorded daily and milk composition weekly. Blood was sampled every two wk. Generalized linear models were used to determine the treatment effect on average daily and cumulative milk production and daily composition, plasma ghrelin, growth hormone, IGF-1, leptin, NEFA and glucose. Mixed models, with cow included as a repeated effect, were used to determine treatment effects on weekly milk production, body weight and body condition score (scale 1-10). Parity, breed, wk of the yr at calving, treatment, wk post-calving and the 2 wk pre-experimental average of each measure (covariate) were included as fixed effects. Despite a numerical tendency for G cows to produce more milk (1,779kg) than either C (1,681kg) or O (1,714kg) cows during the eight wk period, differences were not significant ($P=0.39$). Similarly, there was no significant effect of treatment on milk fat, protein or lactose per cent or yield. Similarly, treatment did not affect DMI. Cows infused with G lost significantly ($P<0.05$) more BCS (0.68 BCS units) over the 8 wk study period than the O infused (0.40 BCS units) or C (0.25 BCS units), which did not differ significantly from each other. Treatment had no significant effect on BW change. Although, treatment did not significantly affect plasma ghrelin, IGF-1, or growth hormone concentration, plasma NEFA concentration was elevated ($P<0.05$) and there was a tendency ($P<0.10$) for plasma leptin to be reduced in G cows. Results indicate an effect of ghrelin infusion on lipolysis.

Key Words: Ghrelin, Obestatin, Dairy

638 Expression of ghrelin and the growth hormone secretagogue receptor 1a (GHS-R1a) in the reproductive tissues of Holstein heifers. M. L. Rhoads*, J. B. Wheelock, L. L. Hernandez, R. P. Rhoads, and R. J. Collier, *University of Arizona*, *Tucson*.

The hormone ghrelin and the active form of its receptor (growth hormone secretagogue receptor 1a; GHS-R1a) are expressed in the reproductive tissues of several species and may be involved in the metabolic regulation of reproductive function. However, little is known about the expression of ghrelin and GHS-R1a in the reproductive tissues of dairy cattle. The objective of this study was to characterize the expression of ghrelin and GHS-R1a in the reproductive tissues of dairy cattle. Reproductive tissues (follicle, CL, ampulla, isthmus, uterine horn, endometrium and uterine body) were collected from three Holstein heifers immediately following slaughter. Samples of the GI tract (reticulum, rumen, omasum, abomasum, duodenum, jejunum, ileum and colon) were simultaneously collected for comparative purposes. Ghrelin and GHS-R1a mRNA abundance were evaluated by real-time RT-PCR. Within the reproductive tract, ghrelin and GHS-R1a gene expression was detectable in all tissues with the greatest expression in the ampulla (0.99 ± 0.09 and 1.94 ± 0.14 AU, respectively; $P<0.001$). Ghrelin expression did not differ based on proximity to the corpus luteum. However, GHS-R1a expression was lower in the ipsilateral ampulla than in the contralateral ampulla (1.14 ± 0.20 vs. 2.75 ± 0.20 AU; $P<0.02$). GHS-R1a mRNA was detected in bovine oocytes and IVF-produced d 8 embryos whereas ghrelin expression was detectable, but low. Among the GI tissues, ghrelin

expression was greatest in the duodenum (12.71 ± 0.65 AU; P<0.001) and was also high in the abomasum (3.27 ± 0.65 AU; P<0.13) while, numerically, GHS-R1a mRNA concentrations were greatest in the ileum (4.45 ± 0.37 AU) and jejunum (3.88 ± 0.37 AU). Both ghrelin and GHS-R1a are expressed throughout the reproductive tract, albeit at lower concentrations than in some GI tissues. The observed patterns of expression suggest that the metabolic regulation of reproduction may be mediated through ghrelin signaling during the early stages of embryo development.

Key Words: Ghrelin, GHS-R1a, Dairy Cattle

639 Seasonal effects on twenty-four hour patterns of melatonin in blood and milk of dairy cows. N. Castro*[1,2], M. T. Kollmann[3], V. Lollivier[4], S. Richter[1], A. Baumert[1], O. Wellnitz[1], and R. M. Bruckmaier[3], [1]*University of Bern*, *Bern, Switzerland*, [2]*Las Palmas de Gran canaria University*, *Las Palmas, Spain*, [3]*Technical University Munich*, *Germany*, [4]*INRA*, *France*.

Pineal secretion of melatonin (MEL) is usually low during light exposure and high during the night. In this study MEL concentration in blood and milk was measured every h during 24 h (7.00 AM-6.00 AM) in June and December in 12 high yielding dairy cows which were housed under natural light conditions in Switzerland, i.e.at 16 and 9 h daylight respectively. Blood samples were taken and the whole available milk was collected by machine milking after an i.v. injection of 1 i.u. of oxytocin every h. No artificial light was used throughout the experiment except for small head lamps during sampling in the dark nights. MEL in blood and milk was determinated by ELISA. For all statistical analyses a general linear model procedure with repeated measures and post hoc Tukey analysis was used. Both MEL blood and milk concentration showed a diurnal pattern with high levels during scotoperiod and low levels during photoperiod. In June melatonin blood levels (pg/ml) were 2.3 ± 0.2 during the day (08.00 to 22.00 h), started to increase at 23.00 h (16.0 ± 3.8) and decreased to baseline at 07.00 h (5.3 ± 2.2). Peak MEL was observed at 01.00 h (25.3 ± 6.2). In December MEL blood levels increased already at 17.00 h (16.3 ± 3.3) and the decrease started at 07.00 h (12.2 ± 2.2) Peak MEL was 40.4 ± 5.2 at 22.00 h. Areas under the curve (AUC) were calculated for samples from 23.00 h to 06.00 h. AUC/h in blood and in milk was higher ($p < 0.05$) in winter than in summer (22.4± 2.4 and 16.2 ± 2.3, 7.2 ± 1.0 and 2.2 ± 0.5, resp.). In all individuals MEL was higher in blood than in milk in both seasons. AUC of milk melatonin concentration was 20 ± 7 % in summer and 35 ± 7 % in winter of the MEL in blood. In conclusion, milk MEL is elevated, in parallel with blood MEL, albeit at a lower level, most likely being transferred by the way of diffusion with water.

Key Words: Melatonin, Daylight, Milk

640 Effect of restricted feeding and monopropylene glycol postpartum on metabolic hormones and postpartum anoestrus in grazing dairy heifers. L. M. Chagas*[1], P. J. S. Gore[1], K. A. Macdonald[1], and D. Blache[2], [1]*Dexcel Limited*, *Hamilton, New Zealand*, [2]*The University of Western Australia*, *Crawley, Australia*.

Pastoral dairying in New Zealand requires a 12 months calving interval to balance cow nutrient demands with pasture growth, however, in 30% of cows postpartum anoestrous interval (PPAI) exceeds 80 days resulting in lost productivity. Supplementary feeding can overcome low pasture availability and a previous study showed that 250 ml of monopropylene glycol (MPG) given twice a day to Holstein-Friesian heifers calving in low body condition score (BCS; 2.8) reduced PPAI. In that study 82% of heifers given MPG were cycling by 12 weeks postpartum compared to 28% of controls. A further study was undertaken with MPG supplements and feed restriction using heifers calving in good BCS (3.1). Treatments comprised of *ad libitum* pasture (Adlib; n=18) and two groups given restricted pasture (RES; n=18) and restricted pasture with MPG (250 ml twice daily; RESM; n=13) given from calving for 150 days. *Ad libitum* feeding resulted in greater BW, milk, protein and fat yield than other groups (P<0.05). Plasma concentration of insulin, IGF-I, growth hormone (GH), leptin, glucose and non-esterified fatty acids (NEFA) were measured weekly. Treatment effects on these constituents were minor, with low concentrations of insulin at week 3 (P<0.05) and greater NEFA concentrations in weeks 2-5 than in the RES heifers than other groups (P<0.05). Restricted feeding lowered leptin concentration relative to Adlib group in weeks 3, 5-7 and 12, and at week 6 when compared to the RESM group (P<0.05). During the metabolic challenge with MPG insulin secretion was stimulated. In the present study there was no difference in PPAI among the groups. We concluded that the most important impact on PPAI in heifers is BCS at calving. Restricted feeding and MPG supplementation of heifers calving in good BCS, affects milk production rather than PPAI. Supplementation with MPG can reduce PPAI of heifers with low BCS (2.8), but when BCS is 3.1 supplements are of little benefit to pasture fed heifers.

Key Words: Postpartum Anestrous, Monopropylene Glycol, Dairy Heifer

641 Hypothalamic genes expression in early- and late-maturing *Bos indicus* heifers. A. Vaiciunas*[1], L. L. Coutinho[2], and L. F. P. Silva[1], [1]*University of São Paulo*, *Pirassununga, SP, Brazil*, [2]*University of São Paulo*, *Piracicaba, SP, Brazil*.

The molecular mechanism by which leptin signaling in the hypothalamus might permit the initiation of puberty has not been elucidated. One possible mechanism for leptin molecular action on the reproductive axis is affecting NPY signaling. It was our objective to test whether early-maturing *Bos indicus* heifers have altered expression of hypothalamic genes related to leptin signaling. Among a population of 500 heifers between 20 and 25 months of age, 100 heifers were selected base on breed attributes (Nelore), month of birth, and body weight (280 to 300 kg). These 100 heifers were scored as prepubertal or pubertal according to the presence or not of a palpable corpus luteum (CL). Ten heifers without a CL and ten heifers with a palpable CL received a prostaglandin injection, and according to visual observation of heat and rectal palpation, 6 prepubertal and 6 pubertal heifers were selected for the experiment. These 12 heifers were slaughtered and samples of hypothalamus were collected and frozen in liquid nitrogen. Expression of Ob-Rb, SOCS-3, NPY, NPY-Y1 and NPY-Y4 was quantified by real-time PCR using the ribosomal protein RP-L19 as a reference gene. Hypothalamic expression of Ob-Rb, SOCS-3 and NPY was not different between groups of heifers. It was thought that late-maturing heifers could be resistant to leptin due to an increased expression of SOC-3, or a decreased expression of Ob-Rb at the hypothalamus, but our results did not corroborate with this hypothesis. There was a tendency for NPY-Y1 and NPY-Y4 expression to be reduced in

heifers that reached puberty earlier (P=0,10). Expression of NPY-Y1 was 8.3-folds lower and NPY-Y4 expression was 14.3-folds lower in early-maturing than in late-maturing heifers. When analyzed together, there was an 11-fold reduction in NPY receptors expression in early-maturing heifers, and this effect was statistically significant (P=0.03). These results suggest that, because of the lower expression of NPY receptors, the hypothalamus of early-maturing heifers could be less sensitive to NPY inhibition, and therefore reach puberty with lower levels of circulating leptin.

Key Words: Bovine, Neuropeptide-Y, Puberty

642 Evaluating reproductive and immune consequences of endocrine disrupting chemicals in an avian bioassay. M. A. Ottinger*[1], E. T. Lavoie[1], and M. J. Quinn[2], [1]*University of Maryland, College Park*, [2]*U.S. Army Center for Health Promotion and Preventive Medicine, Aberdeen, MD*.

The avian embryo provides a self contained system for studying the consequences of exposure to endocrine disrupting chemicals (EDCs). Therefore, the avian embryo is an appealing ′bioassay′ for detecting EDC effects in birds. Japanese quail were used to evaluate endocrine disruption by several EDCs, including estradiol, trenbolone, vinclozolin, methoxychlor, DDE, atrazine, and PCB 126. A number of endocrine, neuroendocrine and immune endpoints were evaluated for endocrine disruption in the Japanese quail embryo, juvenile/maturing, and adult, including serum or fecal estradiol and androgen concentrations, histology and morphology of the bursa and gonad, and hypothalamic aromatase activity, monoamine content and GnRH-I concentration. Maturation and male mating behavior were evaluated post-hatch to compare discernable EDC effects in hatchlings compared to long-term effects impacting reproductive function in adults. Results showed that all chemicals impaired male sexual behavior, regardless of androgenic or estrogenic mode of action. The GnRH-I system in hatchlings was sensitive to many of the EDCs, with up to a 50% decrease in content at some EDC doses. Similarly, hypothalamic dopamine levels were decreased by some EDCs in hatchlings; fewer effects were observed in adults. Gonadal steroids and thyroid gland hormones were decreased with EDC exposures. Immune response show long-term effects of EDC exposure, relative to bursal morphology and antibody responses. Our data provide supporting evidence that even low level exposure to selected EDCs exerts effects on the development of the reproductive axis, with additional impacts on other physiological systems, including the immune system. The embryo appears to be more vulnerable than the adult to sublethal and low level exposure; possibly due to compensation of physiological systems as the animal matures. Multiple endpoints appear to be necessary for detection of endocrine disruption due to differing modes of action and toxicity of EDCs. Supported by EPA R826134010 (Star Grant), NSF 9817024, and EPA R-2877801(MAO).

Key Words: Endocrine Disrupting Chemicals, Reproductive and Immune Systems, Japanese Quail

643 Differential expression of adiponectin, adiponectin receptor 1 (AdipoR1) and leptin mRNA in different adipose depots in sheep. A. Lemor*[1], M. Mielenz[1], M. Altmann[2], E. von Borell[2], and H. Sauerwein[1], [1]*University of Bonn, Germany*, [2]*Martin-Luther-University, Halle-Wittenberg, Germany*.

The adipokines adiponectin and leptin are important in lipid metabolism and glucose homeostasis. Adiponectin is inversely related to leptin secretion and is associated with insulin resistance. Data on the expression of adiponectin and its receptor AdipoR1 are mainly limited to monogastric species, whereas for ruminants corresponding data are scarce. We aimed to characterize mRNA expression for adiponectin, AdipoR1 and leptin mRNA in different sheep fat depots. Subcutaneous (sc) and visceral (vc) fat was dissected from carcasses of 10 male crossbred sheep (40 kg b.w.). Sc fat was sampled at 3 different sites: close to the sternum (S), withers (W) and the base of the tail (T); vc fat was sampled from perirenal (P) and mesenteric (M) depots. The mRNAs of adiponectin, AdipoR1 and leptin were quantified by real-time RT-PCR. For adiponectin, no differences were found between depots (p=0.36); whereas AdipoR1 mRNA concentrations were higher ($p<0.05$) in P compared in W, T and M. Leptin mRNA concentrations were higher in S than in both vc depots ($p<0.05$). Sc leptin mRNA values were correlated with the total sc fat fraction of the carcass ($p<0.05$, r=0.41) but not with vc fat. In contrast, vc adiponectin tended to be correlated with the vc carcass fat (p=0.1, r=0.40) but not with sc. A trend for a correlation was found between AdipoR1 with adiponectin (p=0.08, r=0.36 (sc), p=0.09; r=0.41 (vc)) in both adipose depots. In conclusion, our findings indicate a constant expression of adiponectin mRNA in different sheep fat depots, which is in contrast to reports from monogastric species. AdipoR1 as well as leptin mRNA seems to be differentially expressed in different adipose depots of sheep.

Key Words: Adiponectin, Adiponectin Receptor 1, Leptin

644 Prolactin levels and ovulation rate in crossbreed ewes with induced oestrus during the anoestrous season and the effect of bromocryptine and naloxone. V. O. Fuentes-Hernandez*[1], R. Orozco[1], J. J. Uribe[1], V. M. Sanches[2], and P. I. Fuentes[3], [1]*Universidad de Guadalajara*, [2]*FMVZ Universidad Michoacana de San Nicolas Hidalgo*, [3]*Hospital Pemex Sur de Alta Especialidad Mexico DF*.

With the objective of studying the effect on naloxone and bromocryptine on the ovulation rate and the plasmatic levels of Prolactin in the crossbreed ewe during the anoestrous season. 40 crossbreed ewes were allocated at random in to four groups of 10. All ewes received an intravaginal sponge with 40 mg Medroxiprogesterone acetate for a period of 14 days and on sponge withdrawal 250 I.U. of Ecg was administered by intramuscular injection. During the period of sponge treatment, ewes were medicated as follows: Group 1 (n = 10) was treated with 0.5 mg bromocryptine im at 12 hour intervals. Group 2 (n = 10) was treated as group 1 and an implant of 15 mg of naloxone was applied subcutaneously. Group 3 received a subcutaneous implant of 15 mg NaloxoneGroup and group 4 (n = 10) was sham treated. In group 1 it was observed that bromocryptine decreased significantly ($p<$ .001 Prolactin plasma levels, In group 2 bromocryptine + Naloxone treated ewes plasma Prolactin levels were decreased significantly ($p<.001$) in a similar pattern as observed in group 1. In group 3 prolactine levels were decreased significantly ($p<.05$). Control group 4 prolactine levels remained unchanged. After sponge withdrawasl and eCG injection oestrus was present in all groups. 6 to 8 days after estrus CL were observed by laparoscopy under ketalar xylazne anaesthesia, ovulation rate in bromocriptine and control groups was not significantly different (2.1 ± .4 and 2.2 ± .5 respectively). In bromocryptine

naloxone and naloxone treated ewes ovulation rate was significantly increased as compared with controls (2.9 ± .5 and 3.1 ± .4 Respectively p< .01). It was concluded that endogenous opioids are important modulators of ovulation.

Key Words: Ewe, Estrus, Naloxone

645 Luteinizing hormone-releasing hormone immunization alters pituitary hormone synthesis and storage in bulls and steers. K. J. Wells*[1], T. W. Geary[2], D. M. de Avila[1], J. de Avila[1], V. A. Conforti[1], H. Ulker[1], D. J. McLean[1], A. J. Roberts[2], and J. J. Reeves[1], [1]*Washington State University*, *Pullman*, [2]*USDA ARS Fort Keogh*, *Miles City, MT*.

Objectives of this study were (1) to determine if trenbolone acetate (TBA) co-administered with LHRH immunization would suppress reproductive function in beef bulls and (2) to examine the effects of LHRH immunization and TBA treatment on pituitary function. To address these objectives 44 Angus x Hereford bull calves (mean BW = 225 ± 2 kg; mean age = 187 ± 6 d) were randomized into eight treatments in a 2 × 2 × 2 factorial experiment, with castration, LHRH immunization, and TBA administration as treatment factors. Calves immunized against LHRH received a primary injection of ovalbumin-LHRH-7 fusion protein on d 0, followed by two booster injections on d 42 and 196. Calves treated with TBA were implanted on d 224. Mean LHRH antibody binding activity in serum increased after each booster for immunized calves, but was negligible in non-immunized animals throughout the experiment. Concentrations of testosterone in serum were lower ($P < 0.0001$) by d 84 and scrotal circumference smaller ($P < 0.05$) by d 168 in LHRH immunized bulls compared to non-immunized bulls. Treatment with TBA tended ($P = 0.07$) to decrease concentrations of testosterone in serum from bulls. Testes + epididymides weights at slaughter (d 272) were lighter ($P < 0.0001$) for immunized compared to non-immunized bulls. Both LHRH immunization and castration resulted in decreased anterior pituitary stores of LH and FSH ($P < 0.001$). Immunization against LHRH suppressed expression of the LH β, and common α-subunit genes ($P < 0.0001$), while castration increased expression of the same two genes ($P = 0.02$). Synthesis and storage of LH and FSH, as measured by pituitary LH and FSH content and expression of the LH β-subunit and common α-subunit genes, was suppressed by LHRH immunization.

Key Words: LHRH Immunization, Trenbolone Acetate, Pituitary

646 Glial cell line-derived neurotrophic factor enhances porcine oocyte developmental competence in vitro. K. Linher*[1], D. Wu[1,2], and J. Li[1], [1]*University of Guelph*, *Guelph, Ontario, Canada*, [2]*Sichuan Agricultural University*, *China*.

The success of early embryonic development depends on oocyte nuclear and cytoplasmic maturation. We have investigated whether glial cell line-derived neurotrophic factor (GDNF) affects the in vitro maturation (IVM) of porcine oocytes and their subsequent ability to sustain preimplantation embryo development. GDNF and both its co-receptors, GDNF family receptor α-1 (GFRα-1) and the rearranged during transformation (RET) receptor were expressed in oocytes and their surrounding cumulus cells derived from small and large follicles. When included in IVM medium, GDNF significantly enhanced cumulus cell expansion of both small ($P<0.05$) and large ($P<0.001$) cumulus-oocyte complexes. It also significantly increased the percentage of small follicle-derived oocytes maturing to the metaphase II (MII) stage ($P<0.01$), although the nuclear maturation of large oocytes was not significantly affected. Examination of cyclin B1 protein expression as a measure of cytoplasmic maturation revealed that in the presence of GDNF, cyclin B1 levels were significantly increased in large follicle-derived oocytes ($P<0.05$). Although not significant, cyclin B1 expression was also elevated in small follicle-derived oocytes to levels comparable to untreated large oocytes. After parthenogenetic activation, a significantly higher percentage of both small and large follicle-derived oocytes that were matured in the presence of GDNF developed to the blastocyst stage compared to untreated controls ($P<0.05$). Indeed, GDNF enhanced the blastocyst rate of small follicle-derived oocytes to levels comparable to those obtained for large oocytes matured without GDNF. Our study provides the first functional evidence that GDNF enhances oocyte maturation and preimplantation embryo developmental competence in a follicular stage-dependent manner. This finding may provide insights for improving the formulation of IVM culture systems, especially for small follicle-derived porcine oocytes.

Key Words: GDNF, Oocyte Maturation, Preimplantation Development

Ruminant Nutrition: Corn Milling Co-Products - Dairy

647 Maintaining milk components when feeding co-products of corn ethanol production. L. Armentano*, *University of Wisconsin*, *Madison*.

Use of DGS at 15 to 20% of ration DM may be economical, but requires caution to ensure optimal production of milk protein and fat. DGS can affect milk protein yield through altered diet carbohydrate and protein profile. Adequate dietary degradable protein should be supplied from other sources, and some attention to the lysine concentration in the remaining undegraded protein sources is warranted. However, recent research with modern DGS suggests that lysine content is less of a concern than previously thought. Starch content of the diet should be monitored for adequacy if DGS replaces grain. Laboratories may analyze DGS NDF with Na sulfite and NDFCP without sulfite. Using these values to calculate NFC as 100- ash - CP - NDF - Ether Extract + NDFCP, will overestimate NFC. Several characteristics of DGS may impact milk fat yield and composition. Excess oil may be present in diets with DGS. Different analytical methods (acid hydrolysis ether extract, ether extract variations) may not accurately measure fatty acids in DGS, and this content will vary. To the extent that DGS carbohydrate displaces starch, this will tend to have a positive effect on milk fat production, but care must be taken if DGS NDF replaces physically effective fiber from forages. Low forage fiber combined with high oil could trigger milk fat depression. If DGS is added to low oil diets, and diet oil is thereby increased, there may be less secretion of fatty acids shorter than 16 carbons, however, this may be compensated

for by an increase in 18 carbon fatty acids arising from the increased dietary supply. Adding fat to diets often increases milk yields more than it does milk fat or protein yields. This is generally an economically positive response for low cost oils, but may be interpreted by casual observers as a decrease in fat or protein due to lowered milk fat concentration. Field reports of milk fat depression probably relate to all of the above considerations. New processes will result in co-products that differ in composition from DGS.

Key Words: Distillers Grains

648 Phosphorus utilization in dairy cows fed increasing amounts of dried distillers grains with solubles. K. Mjoun*, K. F. Kalscheur, B. W. Pamp, D. J. Schingoethe, and A. R. Hippen, *South Dakota State University*, *Brookings*.

When phosphorus (P) is fed in excess of the dairy cow′s requirement, an increase in fecal excretion of P is expected, which can lead to environmental pollution. The objective of this experiment was to investigate the effect of dietary concentration and source of P on P utilization in lactating dairy cows. Five multiparous Holstein cows fitted with rumen cannula were used in a 5 × 5 Latin square design with 28-d periods. A basal diet was formulated to contain 0.28% of P. Two additional dietary concentrations of P (0.34 and 0.40%) were formulated by including soybean products (SB), with increasing amounts of a supplemental source of P (dicalcium phosphate) or increasing amounts of dried distillers grains with solubles (DG), without a supplemental source of P. Experimental diets were formulated to provide: 1) 0.28% P (no supplemental P); 2) 0.34% P from SB and 0.18% supplemental P; 3) 0.40% P from SB and 0.36% supplemental P; 4) 0.34% P from DG (11% DG); and 5) 0.40% P from DG (22% DG). With increasing dietary P concentration (0.28, 0.34, and 0.40%), increases in P intake (68.7, 78.7, and 98.4 g/d, $P < 0.001$), fecal P output (28.2, 33.8, and 42.3 g/d, $P = 0.01$), net absorption (31.2, 39.0, and 47.0 g/d, $P = 0.04$)), and net retention of P (4.6, 12.6, and 19.5g/d, $P = 0.07$)) were observed; however, none of these parameters was affected by altering the source of P. Phosphorus excreted in milk was greater ($P = 0.001$) for DG diets compared with SB diets (28.9 and 25.8 g/d) primarily because of greater ($P = 0.01$) milk production for DG diets compared with SB diets, 35.9 and 34.4 kg/d, respectively. Milk P concentration was constant across all diets (0.083% P) regardless of dietary P concentration. Apparent P digestibility was similar for all diets averaging 52.9%. Total and inorganic water soluble P, indicators of P susceptibility to runoff, were unaffected by diet averaging 2.53 and 1.82 g/kg of feces DM, respectively. Data from this experiment suggest that feeding DG can sufficiently meet P requirements of high producing dairy cows without supplementary mineral source.

Key Words: Phosphorus, Fecal Excretion, Dried Distillers Grains with Solubles

649 The effect of replacing corn dry distillers grains with triticale dry distillers grains on milk yield and composition of lactating dairy cows. A. M. Greter*, E. C. Davis, G. B. Penner, and M. Oba, *University of Alberta*, *Edmonton, Alberta, Canada*.

The objective of this study was to compare milk yield and composition of dairy cows fed corn dry distillers grains with solubles (CDDGS) or triticale dry distillers grains with solubles (TDDGS) as a protein supplement. Thirty lactating Holstein cows (128 ± 57 DIM) were used in a crossover design with 14-d periods. Cows were assigned to one of two diets containing either CDDGS or TDDGS, at 20% of dietary DM, with barley silage, alfalfa silage, dry rolled barley, and the premix of minerals and vitamins. Both experimental diets were formulated to contain 16.7% crude protein and 22.0% forage neutral detergent fiber. Dry matter intake and milk yield were not affected by treatment, and averaged 23.2 and 31.5 kg/d, respectively. However, cows fed TDDGS decreased concentration of milk urea nitrogen compared to those fed CDDGS (15.7 vs. 16.6 mg/dl; $P < 0.01$), indicating that less N might be wasted in cows fed TDGGS. There were interactions between parity and treatment for 4%-FCM yield, milk fat concentration, and milk fat yield ($P < 0.05$). Multiparous cows fed TDDGS had greater 4%-FCM yield (32.8 vs. 26.9 kg/d) and milk fat concentration (3.81 vs. 3.46%) compared with primiparous cows fed TDDGS although there were no differences for cows fed CDDGS. In addition, multiparous cows fed TDDGS had greater milk fat yield compared with primiparous cows fed CDDGS or TDDGS (1.29 vs. 1.08 or 1.01 kg/d). These data indicate that high producing dairy cows may benefit more from TDDGS than lower producing cows. Consistent with this speculation, the response in milk yield to TDDGS relative to CDDGS in individual cows was positively related to their pretrial milk yield ($P = 0.03$). The results of this study demonstrate that TDDGS can replace CDDGS without negative impacts on lactation performance, however, its effects on the efficiency of N utilization is of further research interests.

Key Words: Triticale Distillers Grain, Corn Distillers Grain, Milk Production

650 Response of lactating Holstein cows to increased amounts of wet corn gluten feed. M. J. Brouk*[1], J. F. Smith[1], and K. N. Grigsby[2], [1]*Kansas State University*, *Manhattan*, [2]*Cargill, Inc.*, *Blair, NE*.

Forty, lactating Holstein cows were allotted into groups of five animals and assigned to one of eight pens containing 10 freestalls each. Each group contained 3 primiparious and 2 multiparious animals and groups were balanced by milk production and days in milk. Diets were formulated to contain 0%, 12%, 24% or 36% WCGF (wet corn gluten feed) on a dry matter basis. Increasing levels of WCGF and heat treated expeller soybean meal replaced a portion of the corn silage, alfalfa hay, corn grain, soybean meal and soybean hulls of the 0% diet to maintain similar concentrations of crude protein, ruminally undegraded crude protein and neutral detergent fiber. A 4×4 Latin square design with 4-wk periods allowing for 2 wk of adjustment followed by 2 wk of data collection was utilized. Milk weights were recorded at each milking and weekly milk samples, am and pm, were collected for milk component analysis. Milk and feed data were averaged by pen and week prior to analysis. Addition of WCGF to the diet reduced the dry matter content of the TMR. Dry matter intake was unaffected (P>0.1) by treatment. Cows fed 36% WGCF produced more (P<0.01) milk for diets containing 0%, 12%, 24% and 36% WGGF (36.6, 37.6, 38.8 and 40.5 kg/cow/d, respectively). Percentages of milk fat and lactose were unaffected (P>0.1) by diet. Diets containing either 24 or 36% WCGF resulted in greater (P<0.01) 4% fat and energy corrected milk production as compared to diets with 0 or 12% WCGF. Production of milk fat and protein was greater (P<0.01) when feeding WCGF. Increased milk, protein and fat production with increasing amounts of WCGF without a change in DM intake, suggests that total diet digestibility was increased when WCGF replaced diet ingredients that

were possibly less digestible than WCGF. Diets containing WCGF also resulted in greater (P<0.01) fat intake due to the fat associated with WCGF. These data show that WCGF can be utilized effectively at 36% of the ration dry matter if concentrations of RUP, CP and NDF are maintained in the diet.

Key Words: By-Products, Corn Milling, Nutrition

651 Increased diet fermentability reduces production response to corn distiller's grains in lactating cows: A statistical analysis. M. Hollmann*, D. K. Beede, and M. S. Allen, *Michigan State University*, *East Lansing*.

Increasing supply of corn distiller's grains (DG) has raised questions regarding the extent to which they can be used in dairy cow diets. A database was created of treatment means (n = 122) reported in 23 peer-reviewed journal articles published between 1982 and 2006. The database included 4% fat-corrected milk yield (FCM) response to DG treatment compared with control (no DG), DG (% of dietary DM), and various indicators of diet fermentability including forage type, concentration of cereal grain in DG diet, and grain fermentability. Forage type was classified as alfalfa (n = 27), corn silage (n = 49), or a mixture of each (n = 46), grain concentration was classified as high (> 20% of dietary DM; n = 34) or low (≤ 20 % of dietary DM; n = 13), and grain fermentability was classified as high moisture corn (HMC; n = 9) or dry corn (DC; n = 38); responses with diets including more than one grain source (n = 8) were eliminated from the analysis. Supplementation of DG ranged from 4.2 to 42% of dietary DM. Response to DG ranged from -5.0 to 5.6 kg/d for FCM (mean = 0.6 kg/d), but response was not related to DG concentration of diets (P > 0.15). Fat-corrected milk yield was affected by forage type (P < 0.001), percent grain (P < 0.01), and grain fermentability (P < 0.03); these three factors explained 56% of the variation in FCM from DG supplementation. Among forage types, FCM response to DG was greatest for alfalfa (2.6 kg/d), lowest for corn silage (-2.1 kg/d), and intermediate for the mixture (1.3 kg/d). Response of FCM to DG was greater when concentration of corn grain in the diet was low (1.5 kg/d) compared with high (-0.2 kg/d) and for DC (1.1 kg/d) compared with HMC (0.1 kg/d). Increasing fermentability of forages (corn silage > alfalfa), corn grain (HMC > DC), and increasing the grain concentration of diet resulted in lower and sometimes negative FCM responses to DG supplementation. Fat-corrected milk yield response to DG supplementation is likely greatest when diet fermentability is limited.

Key Words: Milk Fat Depression, Ethanol Byproduct

652 Dried distillers grains + solubles from wheat fed to dairy cows. T. Andersson*[1], M. Murphy[1], E. Nadeau[2], and M. Carlsson[2], [1]*Lantmännen Feeds*, *Stockholm, Sweden*, [2]*Swedish University of Agricultural Sciences*, *Skara, Sweden*.

The coproduct, dried distillers grains + solubles (DDGS), from ethanol production for biofuels based on wheat, has more RDP and NDF with a lower digestibility compared to DDGS from corn. To compliment wheat DDGS in diets based on grass silage the silage should be low in protein and high in digestible fiber (DNDF). Four groups of dairy cows (10 per group) were used in a 4 by 4 Latin Square experiment with four treatments and four 3-wk periods. The treatments were a normal grass-clover silage (17.8% CP, 46.2% NDF) with 1 kg DDGS (C), an adapted silage (14.6% CP, 52.9% NDF) with 1 kg DDGS (A), 2.5 kg DDGS (A+2.5) or with 4 kg DDGS per cow and day (A+4). The Total Mixed Rations (TMR) had similar contents of CP (17.5%), starch (17.5%), and NDF (37.5%). Diet A+4 had less DNDF and more RDP. TMR were fed ad lib. Intake was recorded on the last 10 days and milk production on the last 4 days of each period. Fecal samples were collected from three cows in each group for analysis. Data were analyzed with PROC GLM in SAS. DMI was greater for A+4 (23.9 kg) than for A and A+2.5 (22.5 kg; SEM=0.40). Diet A tended to give a higher milk yield, 38.3 kg d-1, than C, 37.1 kg d-1 (SEM=0.35), as well as a higher ECM. Diet A produced more ECM per kg of DM intake than A+4 and C, 1.81 vs.1.63 (SEM=0.042). Diets A+2.5 and A+4 gave higher percentages of milk fat than diet A, 4.12 vs. 4.01% (SEM=0.03). Diet A gave the highest percentage and yield of milk protein (3.52 vs. 3.47%, SEM=0.01 and 1.32 vs. 1.27 kg, SEM=0.01). Diet A+4 resulted in a higher body condition score (3.01) than diets C (2.92) and A+2.5 (2.87; SEM=0.03). Fecal pH was lowest for A (6.97 vs. 7.55; SEM=0.11). The declining milk protein contents in A+2.5 and A+4 compared to A might indicate lower protein quality in wheat DDGS. Inclusion of DDGS was positive for milk fat percentage, probably related to the fiber content. Grass-clover silage and 5% of DDGS gave similar performance as adapted grass silage and 20%

Key Words: DDG+S, Silage, Dairy Cows

653 Interactions of yeast culture and dried distillers grains plus solubles in diets of lactating dairy cows. A. R. Hippen*[1], D. J. Schingoethe[1], K. F. Kalscheur[1], P. Linke[1], K. Gross[1], D. Rennich[1], and I. Yoon[2], [1]*South Dakota State University*, *Brookings*, [2]*Diamond V. Mills, Inc.*, *Cedar Rapids, IA*.

Sixteen multiparous Holstein cows (127 ± 52 DIM) were used in four replicated 4 × 4 Latin squares with 4-wk periods to evaluate interactions of dietary yeast culture (YC, Diamond V XPC™ Yeast Culture, Diamond V Mills, Cedar Rapids, IA) and dried distillers grains plus solubles (DDGS) on production of milk and milk components when fed diets containing low amounts of forage fiber. Treatments were a 2 × 2 factorial arrangement of: 1) no YC with no DDGS (NYND); 2) no YC with DDGS at 20% of diet DM (NYD); 3) 14 g/d YC with no DDGS (YND); and 4) 14 g/d of YC with DDGS (YD) at 20% of diet DM. Diets consisted of corn silage (27%), alfalfa hay (18%), and a concentrate mix (55%) on a DM basis. Diets were isocaloric and isonitrogenous. Forage NDF was calculated to be 19.3% of diet DM. Dry matter intake (26.0 kg/d) was similar for all diets. Milk production (42.5, 41.6, 44.8, and 42.3 kg/d for NYND, NYD, YND, and YD, respectively) increased (P = 0.05) with the addition of YC and decreased (P = 0.04) in diets containing DDGS. Milk fat percentage (3.23, 3.07, 3.21, and 3.00%) and yield (1.38, 1.26, 1.44, and 1.28 kg/d) were decreased (P < 0.05) by the addition of DDGS but were not affected by YC. Milk true protein concentrations (3.05, 3.04, 3.02, and 3.08%) were similar for all diets; however, the addition of YC increased (P = 0.05) yield of true protein (1.29, 1.26, 1.35, and 1.30 kg/d). Concentrations of MUN (11.2, 10.9, 10.7, and 12.4 mg/dl) increased (P < 0.01 for YC × DG) when both YC and DDGS were included in the diet. The DDGS decreased (P = 0.02) yields of energy-corrected milk (ECM; 41.1, 39.1, 43.0, and 39.7 kg/d) and tended to decrease (P = 0.08) feed efficiency (1.56, 1.53, 1.66, and 1.53 kg ECM/kg DMI). Body weights and condition scores were not affected

by treatments. Results suggest that, in diets containing minimal amounts of forage fiber, DDGS at 20% of diet DM will contribute to milk fat depression. The addition of YC did improve milk and milk protein yields but did not prevent milk fat depression caused by DDGS. Production responses to YC were similar when cows were fed DDGS or non-DDGS diets.

Key Words: Yeast Culture, Distillers Grains, Lactating Cows

654 Lactation performance of cows fed diets using soybean or byproduct protein sources. Z. Wu* and J. D. Ferguson, *University of Pennsylvania*, *Kennett Square*.

Milk production and economic returns were determined for dairy cows fed diets utilizing soybean or byproduct protein sources. Thirty-nine Holsteins (averaging 95 DIM, SD = 54) were utilized in an 8-wk trial. The soy diet utilized 16% soybean meal and roasted soybeans as the sole supplemental protein source, whereas the byproduct diet used 6.5% mixed fishmeal, brewer's grain, and corn gluten feed (equal proportions) to replace part of the soy combination while still containing 10% soybean meal and roasted soybeans. The diets contained 50% forage, with 30% contributed from corn silage; the remaining forage was alfalfa silage during the first 4 wk (period 1) or sorghum silage for the second 4 wk (period 2). Average DMI was similar between protein sources in both periods. Milk yield was higher during the first half than the second half of the trial, but similar between protein sources in each period. Milk fat and protein concentrations and FCM increased during the second part of the trial, but did not differ between protein sources. Milk fat and protein yields did not differ during the trial or with protein source. There was no interaction between protein and forage sources in lactation measurements. Economic analysis using averages of the two periods showed $0.21/d less on feed cost and $0.13/d more in income over feed for soy than byproduct protein sources. Soy protein source resulted in better economic returns than mixed fishmeal, brewer's grain and corn gluten feed with similar milk production responses. (Partially supported by Pennsylvania Soybean Promotion Board, Salisbury, MD)

Table 1.

Item	Period 1 Byproduct	Soy	Period 2 Byproduct	Soy	SEM	*P*[1] P	T	P x T
DMI, kg/d[2]	23.0	23.4	22.0	22.4	...	...	...	...
Milk, kg/d	33.5	32.8	31.7	31.8	0.8	0.01	0.77	0.31
Fat, %	3.67	3.65	3.79	3.73	0.10	0.06	0.77	0.70
Fat, kg/d	1.165	1.159	1.132	1.124	0.049	0.30	0.91	0.97
FCM, kg/d	33.8	34.5	32.9	33.2	0.8	0.02	0.65	0.68
Protein, %	2.97	2.97	3.15	3.14	0.04	0.01	0.97	0.56
Protein, kg/d	0.995	0.987	0.997	1.000	0.021	0.75	0.99	0.52

[1]*P* values for P = period, T = treatment, and P x T = period by treatment interaction. [2]Group average.

Key Words: Feed Protein Source, Milk Production, Dairy Cow

655 Ruminal fermentation and total tract apparent digestibility in dairy cows fed increasing concentrations of corn germ. M. M. Abdelqader*, A. R. Hippen, D. J. Schingoethe, and K. F. Kalscheur, *South Dakota State University*, *Brookings*.

Four multiparous Holstein canulated cows (132 ± 36 days in milk) were used in a multiple 4 × 4 Latin square design with 4-wk periods to determine the effects of feeding corn germ on ruminal fermentation and total tract apparent digestibilities. Diets were formulated with increasing concentrations of corn germ at 0, 7, 14, and 21% of the diet DM. All diets contained 55:45 forage to concentrate ratio, where forage was 60% corn silage and 40% alfalfa hay. Dietary fat increased from 4.6% in the control diet to 8.3% at the highest inclusion rate of corn germ. Feeding increasing concentrations of corn germ resulted in a quadratic response in DMI (24.5, 27.7, 27.0, 24.1 kg/d; $P < 0.05$). Ruminal pH tended to linearly decrease (6.49, 6.51. 6.41, 6.37; $P = 0.08$) as concentrations of corn germ increased in the diet. Dietary treatments had no effect on the total concentrations of VFA; however, increasing the concentrations of corn germ linearly decreased the molar proportion of acetate (62.8, 61.6, 61.9, 59.4; $P < 0.001$) and linearly increased the molar proportion of propionate (20.9, 21.9, 21.5, 23.4; $P < 0.001$). Increasing corn germ in the diet had no effect on the total tract apparent digestibility of DM, CP, ether extract and total fatty acids. The addition of corn germ resulted in an increase in the total tract digestibility of C18:2 (95.8, 97.3, 97.8, 98.4 %; $P < 0.01$) and C18:1 (80.9, 88.4, 92.0, 90.0%; $P < 0.001$). However, total tract apparent digestibility of C18:0 and total C18 fatty acids were not affected by dietary treatments. Inclusion of corn germ in dairy cow diets had no adverse effect on ruminal fermentation and total tract nutrient utilization. Corn germ provides an alternative fat source in dairy cow diets.

Key Words: Corn Germ, Dairy Cows, Fermentation

656 Wheat grain as a prepartum cereal choice to ease periparturient stress in Holstein cows. H. Amanlou[1], D. Zahmatkesh[1], and A. Nikkhah*[1,2], [1]*Department of Animal Science*, *Zanjan, Iran*, [2]*Department of Animal Science*, *Winnipeg, MB, Canada*.

Wheat grain is a unique cereal rich in easily-fermentable starch and low in cation-anion difference. The controlled prepartum dietary inclusion of wheat grain, thus, has the potential to ease adapting the rumen environment to the high-starch lactation diets, stimulate feed intake, reduce hypocalcemia by reducing extracellular alkalinity and a moderate induction of bone resorption, and improve milk yield in periparturient cows. Our principal objective was to underline the importance of wheat grain as a proper cereal choice in the preparturient diet. Twenty-four dry multiparious cows and sixteen pregnant heifers were blocked based on parity and projected calving date and fed a prepartum diet containing either 1) ground wheat grain (WG) or 2) ground barley grain plus wheat bran (BGW i.e., control diet) from 28-d prepartum until parturition. Cows were kept in loose houses, group-fed, and fed the BGW diet during 21-d postpartum. Feeding WG instead of BGW increased blood glucose (58.3 vs. 52.8 mg/dl, P=0.01), attenuated hypocalcemia (9.5 vs. 7.8 mg/dl, P<0.01), and reduced urine pH (6.4 vs. 6.9, P<0.01) at 7-d prepartum. At 1-d postpartum, WG-fed cows had higher blood glucose (63.0 vs. 56.2 mg/dl, P=0.03) and calcium (7.0 vs. 5.5 mg/dl, P<0.01) than BGW-fed cows. Prepartum feeding of WG instead of BGW led to enhanced (P<0.05) milk fat percent (3.7 vs. 3.5%) and 3.2% fat-corrected milk yield (34.8 vs. 31.3 kg/d) during 21-d postpartum. Blood proteins at 7-d prepartum were higher (P<0.05) and placenta was expelled sooner (P=0.08) in

wheat grain-fed cows than in other cows. Treatments did not affect milk protein; changes in body condition score; total time spent eating, ruminating, and chewing; blood levels of urea nitrogen, cholesterol, and phosphorous; fecal pH; and calving difficulty. Therefore, the prepartum provision of WG (18% on a dry matter basis) instead of BGW proved effective in the simultaneous improvement of calcium and energy states, and thereby, in easing the periparturient stress in Holstein cows.

Key Words: Holstein Cow, Periparturient Stress, Wheat grain

Ruminant Nutrition: Intake and Performance - Beef

657 Factors affecting residual feed intake in feedlot steers. J. W. Homm*, L. L. Berger, and S. L. Rodriguez-Zas, *University of Illinois*, *Urbana*.

Profitability in beef production is a function of both inputs and outputs. The beef industry has focused on outputs such as weight, gain, and carcass merit. Feed costs are estimated to be approximately 60% of the total cost of production, and therefore represent an opportunity to increase profitability through improving feed efficiency. Four hundred six steers (330.1 + 47.07 kg) originating from four different sources and from 29 different Simmental, Angus, and Simmental X Angus sires were used to determine factors affecting feed efficiency in feedlot steers. Seven dietary treatments were used that were composed primarily of corn, corn-based co-products and/or soy hulls. Daily individual animal intakes were recorded by the Growsafe® feed monitoring system. All steers were weighed and ultrasound measurements of marbling score, backfat thickness, and ribeye area were taken approximately every 28 d through 146 d. A total pen collection method established the digestible energy (DE) content of each diet. Residual feed intake (RFI, Mcals of DE/d) was not ($P > 0.05$) correlated to body weight (BW) or average daily gain. However, RFI was highly positively correlated to DE intake (Mcals/d) and average daily dry matter intake (ADDMI). RFI was negatively correlated to gain to feed (G:F) and was lowly, but significantly correlated to empty body fat. G:F was highly correlated to BW, average daily gain (ADG), ADDMI, and DE intake. Dietary treatment accounted for the majority of the variation (43%) in RFI. Dietary treatment and ADG accounted for approximately 51% of the variation in intake over maintenance requirements. Steers that ate more than 15 Mcals of DE per day over their maintenance requirements were less efficient than those eating less than 15 Mcals of DE per day over their maintenance requirements. Sire effects accounted for 9% of the variation in RFI. The range of RFI for progeny of the 29 sires was -2.10 to 2.22 Mcals of DE per day.

Key Words: residual Feed Intake, Steers, Feed Efficiency

658 The effect of residual feed intake rank in beef cows on forage intake and pasture carrying capacity. A. Meyer*, R. Kallenbach, M. Kerley, and K. Ladyman, *University of Missouri*, *Columbia*.

During the summer of 2005, residual feed intake (RFI) was calculated for 42 purebred Hereford heifers using the GrowSafe feed intake system. The heifers were ranked by RFI and split into low RFI (highly efficient), mid RFI, and high RFI (lowly efficient). After their first calving season, the low and high RFI groups were used to determine the difference in their grazed forage intake. Each group was split into two reps and grazed non-endophyte infected tall fescue-based pastures (1.8-2.4 ha/paddock) for 84 d. The cows were weighed on d 0, 21, 42, 63, and 84 and body condition scored (BCS) on d 0, 42 and 84. At the beginning of the experiment and every 21 d thereafter, the grazed pastures were sampled for DM on offer. To measure forage accumulation, each paddock had 10 exclosures that were sampled for forage DM and moved every 21 d. Rising plate meter (RPM) readings were taken weekly, and paddock size was adjusted as needed to keep forage availability similar between groups. RPM readings and date of experiment were used in a stepwise model selection to predict forage DM yield. These yields and exclosure growth data were then used to calculate dry matter intake (DMI). Low and high RFI groups did not differ ($P>.05$) in BW change or BCS change over the trial (19.5 vs. 22.1 kg and 0.11 vs. 0.10 BCS). The average DM yield for all paddocks was 2336 kg DM/ha. The average NDF, ADF, and CP were 72.1, 42.4, and 6.8%, respectively. Low RFI cows had a 21% numerically lower DMI than high RFI cows (12.4 vs. 15.6 kg, $P=0.23$). The average acres needed per paddock over the trial was numerically less for low RFI than high RFI cows (1.71 vs. 1.82 ha, $P=0.35$). The average DM on offer over the trial tended to be lower for low RFI than high RFI cows (4215 vs. 4376 kg, $P=0.06$). Although differences seen between low and high RFI cows were not statistically different, this could be due to the difficulty of measuring forage intake during the growing season and the low number of replications. Additional studies are necessary to confirm these differences.

Key Words: Beef Cows, Feed Efficiency, Forage Intake

659 Evaluation of feed efficiency in Santa Gertrudis steers and relationships with temperament and feeding behavior traits. R. R. Gomez*[1], B. M. Bourg[1], Z. D. Paddock[1], G. E. Carstens[1], P. A. Lancaster[1], R. K. Miller[1], L. O. Tedeschi[1], D. K. Lunt[2], S. A. Moore[3], and D. S. DeLaney[3], [1]*Texas A&M University*, *College Station*, [2]*Texas A&M University*, *McGregor*, [3]*King Ranch*, *Kingsville, TX*.

The objectives of this study were to characterize feed efficiency traits in growing calves, and to examine their relationships with temperament and feeding behavior traits. DMI and feeding behavior traits were measured over a 70-d period using a GrowSafe® feeding system, following a 28-d adaptation period, in Santa Gertrudis steers (n = 118, initial BW = 308.8 ± 27.8 kg). Meal duration (min/d) and meal frequency (meals/d) were averaged over the 70-d period. Body weights were measured at 14-d intervals. Steers were fed a roughage based diet (ME = 2.26 Mcal/kg DM). Chute scores (1 to 5) were recorded and exit velocity (EV) measured as the rate of distance traveled (m/s) while exiting a confined area on days -28, 0, and 70. Residual feed intake (RFI) was calculated as the residual from the linear regression of DMI on mid-test BW^0.75 and ADG. Overall mean (±SD) of ADG, DMI and RFI were 0.84 ± 0.16, 9.44 ± 0.99, and 0.0 ± 0.86 kg/d respectively. RFI was correlated ($P < 0.05$) with DMI (0.86) and feed conversion ratio (FCR; 0.50), but not with ADG or MBW. Steers with low RFI consumed 19.1% less DMI and had 18.7% lower FCR than steers with high RFI. Meal duration was not correlated with ADG or FCR, but was moderately correlated ($P < 0.05$) with DMI (0.35) and RFI (0.34). Meal frequency was not correlated with ADG, FCR, DMI

or RFI. Initial CS and EV were both correlated ($P < 0.05$) with ADG (-0.26, -0.28), but not with DMI. Initial CS tended to be correlated ($P < 0.10$) with FCR (0.17) but not with RFI. Initial EV was not correlated with any other performance, efficiency, or feeding behavior traits. Initial CS was correlated with meal duration but not meal frequency. These results suggest that initial temperament traits may be predictive of subsequent performance of growing calves.

Key Words: Temperment, Feeding Behavior

660 Relationships of feed efficiency with carcass and non–carcass tissue composition in Angus bulls and heifers. F. R. B. Ribeiro*[1], G. E. Carstens[1], P. A. Lancaster[1], L. O. Tedeschi[1], and M. E. Davis[2], [1]*Texas A&M University*, *College Station*, [2]*The Ohio State University*, *Columbus*.

Objectives of this study were to characterize feed efficiency traits and examine their relationship with carcass and non-carcass tissue composition in Angus bulls and heifers. Individual DMI were measured in Angus bulls (n = 16) and heifers (n = 16) fed a corn-based diet (ME = 2.85 Mcal/kg) for 70 d using Calan gates. BW was measured at 14-d intervals. Residual feed intake (**RFI**) was computed as the residual from the linear regression of DMI on mid-test $BW^{0.75}$ and ADG within gender. Low RFI calves consumed 17% less feed than high RFI calves, but had similar ADG and BW. Within bulls and heifers, calves were separated into two groups: high and low RFI (n =8/gender). Upon harvest, gastrointestinal tract (**GIT**) and visceral organs were removed, dissected, and weighed. The 9-11th rib tissue was analyzed for protein and lipid content. There were no significant differences between low and high RFI groups for final BW (360.7 ± 42.4 kg), HCW (259.5 ± 44 kg) and empty BW (**EBW**; 384.3 ± 61.5 kg). There were also no significant difference for total internal fat (82 ± 20.1 g/kg EBW), and carcass lipid (30.3 ± 6.8 %), however low RFI calves had greater ($P < 0.05$) carcass protein content than high RFI calves (15.7 vs. 15.1 %). RFI groups had similar liver (13.5 ± 1.3 g/kg EBW) and heart (3.8 ± 0.3 g/kg EBW), however low RFI calves had smaller empty GIT than high RFI calves (99.3 vs. 103.6 ± 1.52 kg). As expected, heifers had more carcass lipid (35.3 vs. 25.9 ± 1 %) and IF (101.1 vs. 65.98 ± 2.2 g/kg EBW) than bulls. These results showed that RFI had minimal effects on carcass and non-carcass tissue composition.

Key Words: Carcass, Non–Carcass, Residual Feed Intake

661 The effects of sorting steers by weight into calf-fed, summer yearling and fall yearling feeding systems. D. R. Adams*, T. J. Klopfestein, G. E. Erickson, M. K. Luebbe, and M. A. Greenquist, *University of Nebraska*, *Lincoln*.

Cattle are commonly sorted at weaning into different production systems. Our objective was to determine if sorting cattle by BW decreases variation in HCW and decreases overweight carcasses (431 kg). Steers (n=288) were purchased from two ranches in the fall. All the cattle were assigned randomly into sorted or unsorted groups (n=144). The unsorted group was then assigned randomly to one of three feeding times: calf-fed, summer yearling or fall yearling. The calf-feds were fed from November to May. The summer and fall yearlings grazed cornstalks together through the winter until spring and then grazed cool season grass until May. The summer yearlings entered the feedlot in May and were fed until October. The fall yearlings grazed pasture until September when they entered the feedlot and were fed until January. In the sorted group, the heaviest 1/3 were fed as calf-feds. When the cattle were brought off of grass in May, the heaviest 1/2 of the remaining sorted group were fed as summer yearlings, while the lightest 1/2 went to pasture and then were fed until January. Both the sorted and unsorted groups were treated as one group during grazing. When entering the feedlot, the cattle were assigned randomly into six pens per group per feeding time and pen was experimental unit. Sorting cattle did not affect overall performance. There was no affect on HCW, ADG, gain efficiency, yield grade 4 and higher, fat thickness, and marbling ($P > 0.21$). Sorting cattle decreased the variation in HCW and the number of carcasses over 431 kg. Carcass weights were 389 kg, S. D. = 30 kg for sorted cattle compared to 390 kg, S. D. = 48 kg for unsorted cattle. The unsorted group had 20.8% of the carcasses heavier than 431 kg while only 7.04% of the carcasses were over 431 kg in the sorted group. Sorting cattle decreased the variation of HCW and the number of overweight carcasses without affecting fat thickness.

Key Words: Carcass Characteristics, Feedlot Cattle, Sorting

662 The effect of Bos Koolus fed during summer on the feedlot performance and carcass characteristics of steers. I. Loxton[1], T. Grant[2], D. Reid[3], R. Lawrence*[4], and N. Kempe[5], [1]*Beef Support Services*, *Yeppoon, Queensland, Australia*, [2]*Department of Primary Industries and Fisheries*, *Theodore, Queensland, Australia*, [3]*Department of Primary Industries and Fisheries*, *Rockhampton, Queensland, Australia*, [4]*Integrated Animal Production*, *Toowoomba, Queensland, Australia*, [5]*Feedworks*, *Burleigh Heads, Queensland, Australia*.

Feedlot cattle over summer experience high heat load events that increase core body temperature, reduce feed and water intake, depress animal performance and increase morbidity. Mortalities may result. To manage the consequences of high heat load, the dietary inclusion of betaine, an osmolyte was studied. In an unreplicated pilot study, 32 Angus and Angus crossbred steers were fed a diet with or without 20 g/d betaine incorporated as a Bos Koolus (BK) supplement for 100 days over summer from December 2005 to March 2006 in a central Queensland, Australia feedlot research facility. All steers had access to shade. Nineteen of the steers (10 Control and 9 BK) were surgically implanted with Sirtrack digital temperature transmitters adjacent to the peritoneum at a paralumbar site. Animal measurements included growth, core body temperature at 15 minute intervals, and carcase attributes at slaughter. Climatic parameters were measured in an unshaded environment every 30 minutes enabling calculation of Accumulated Heat Load Units (AHLU). Three significant heat load events, with AHLU to 130 were recorded during the study. Bos Koolus inclusion showed some evidence of increased overall steer growth (1.21±0.07 SEM vs. 1.17±0.07 SEM kg/d), increased exit liveweight (598.6±6.7 SEM vs. 594.4±5.2 SEM kg) increased carcase weight (314.0±4.3 SEM vs. 306.1±2.2 SEM kg), increased subcutaneous fat depth (16.6±1.1 SEM vs. 14.4±0.7 SEM mm, P8 site), while overall DMI (9.92 vs. 9.67 kg/d) and water consumption (37.0 vs. 33.3 L/d) increased, compared with Control. The average core body temperatures of both Control and Bos Koolus treated steers were similar. Therefore, Bos Koolus has shown potential to ameliorate the effects of heat stress in feedlot cattle.

Key Words: Beef Cattle, Betaine, Heat Tolerance

663 Effect of Ractopamine HCl on growth and carcass traits of finishing heifers fed to slaughter. S. B. Laudert*, G. J. Vogel, A. L. Schroeder, and W. J. Platter, *Elanco Animal Health*, *Greenfield, IN*.

Two studies were conducted at research facilities in TX and KS to evaluate the effects of ractopamine hydrochloride (RAC) on growth performance and carcass traits of finishing heifers. The studies consisted of 3 treatments (0, 200 mg•hd^{-1}•d^{-1} and 30.3 ppm RAC), 14 replications per treatment and 3405 cattle (492.8 kg). Days on feed averaged 142 and 185, with the RAC diets fed for the last 28 and 32 d prior to slaughter at the TX and KS sites, respectively. Rations were representative of the geographic area of the studies and met or exceeded National Research Council nutrient requirements of finishing heifers. Rumensin®, Tylan® and MGA® were fed at label dosages. TX heifers received an initial Revalor® IH followed by Revalor H re-implant approximately 77 d pre-slaughter. KS heifers received a Revalor 200 at processing and were not re-implanted. Heifers were slaughtered at commercial beef facilities and standard carcass data collected. Data were analyzed using a mixed model procedure of SAS with pen as the experimental unit and initial weight as a covariate. Feeding RAC at 200 mg•hd^{-1}•d^{-1} or 30.3 ppm increased live weight gain, lowered feed intake and improved feed conversion. Heifers fed the RAC diets had heavier carcass weights, and increased dressing percentages and LM areas compared to heifers fed the control diet. Dietary RAC treatment did not impact marbling score, fat thickness, KPH, or yield grade. Feeding RAC to heifers for the final 28 to 32 d of the finishing period increased live weight and carcass gain and improved feed efficiency with no impact to carcass quality.

Table 1. Effect of Ractopamine on finishing heifers

Item / RAC Treatment	0	200 mg	30.3 ppm	SE
RAC intake, mg•hd^{-1}•d–^{1}	0	200	234	
Final weight, kg	525.2^{a}	528.6^{b}	531.2^{c}	.9
DM intake, kg	7.99^{a}	7.76^{b}	7.76^{b}	.21
ADG, kg	1.07^{a}	1.19^{b}	1.27^{c}	.03
F:G	7.62^{a}	6.70^{b}	6.26^{b}	.23
G:F	.133^{a}	.151^{b}	.162^{c}	.015
HCW, kg	336.8^{a}	341.4^{b}	342.9^{b}	.7
% dress	64.17^{a}	64.63^{b}	64.55^{b}	.04
12th rib fat, cm	1.27	1.24	1.27	.03
KPH, %	2.10	2.07	2.09	.01
LM area, cm^{2}	91.4^{a}	92.8^{b}	92.9^{b}	.58
Yield grade	2.55	2.49	2.51	.04
Marbling score	Slight^{96}	Slight^{95}	Slight^{94}	3.6

^{abc} (P < .05)

Key Words: Ractopamine, Heifer, Growth and Carcass

664 Plasma urea-N response to dosages and delivery patterns of Estradiol 17-beta and Trenbolone Acetate. S. L. Parr*, R. H. Pritchard, and K. W. Bruns, *South Dakota State University*, *Brookings*.

Two experiments were used to assess the effect of implant dose and delivery pattern on anabolic status via plasma urea-N (PUN) concentrations when steers were fed finishing diets. In Exp.1 crossbred steers (n=64; BW=368 kg) received the following implant dosages (IMP) of estradiol (E) and trenbolone acetate (TBA) in milligrams given on d 0; 1) 0E/0TBA; 2) 8E/40TBA; 3) 16E/80TBA; and 4) 24E/120TBA. Blood was drawn (n=40) on d 0, 2, 7, 14, 21, 28, 42 and 70. Implants increased 136 d ADG (1.2^{c}, 1.4^{b}, 1.4^{b}, and 1.6^{a} kg/d; $P < 0.05$) and HCW (330^{c}, 347^{b}, 345^{b}, and 362^{a} kg; $P < 0.05$). Concentrations of PUN averaged across days 28, 42 and 70 were higher for IMP 1 than IMP 2 or 4 (9.5^{a}, 7.7^{b}, 8.1^{ab} and 7.4^{b}; $P < 0.05$) and tended to be higher than IMP 3 ($P < 0.10$). In Exp.2 steers (n=192; BW=372 kg) received one of 4 IMP treatments, IMP A) 0E/0TBA and 3 implanted strategies which resulted in equal cumulative dosages of E and TBA: IMP B) 8E/40TBA given on d 0, 42, and 84; IMP C) 12E/60TBA on d 0 and 63; and IMP D) 24E/120TBA on d 0. Steers were sorted to IMP within frame size (FSL=large; FSS=small). Blood was drawn (n=72) on d -1, 41, 62, 83 and d 125. Implanted cattle had greater ($P < 0.05$) 133 d ADG and HCW than control. Concentrations of PUN increased from d 0 to 125 (6.4, 7.7, 8.9, 10.2, and 10.5 mg/dl; $P < 0.05$). At d 41, implants lowered PUN concentrations (8.5^{a}, 7.7^{b}, 7.2^{b} and 7.4^{b} mg/dl; $P < 0.05$). At d 62 PUN concentrations were lower for IMP B and C compared to control; IMP D PUN concentration were intermediate (9.8^{a}, 8,3^{b}, 8.4^{b} and 9.0^{ab} mg/dl; $P < 0.05$). A FS x IMP interaction existed at d 83 and d 125. In FSL, IMP did not affect PUN (10.4 mg/dl; $P > 0.10$) at these times. However, in FSS the PUN concentrations were lower for IMP B and C than IMP A or D (11.6^{a}, 9.5^{b}, 9.1^{b}, 11.0^{a} mg/dl; $P < 0.05$). In Exp.2 smaller framed steers did have an increased response to implant delivery patterns that involved repeated lower dosing. The observed changes in PUN concentrations were responsive to time but not to dosage.

Key Words: Anabolic Implant, Estradiol 17-beta, Trenbolone Acetate

665 Using programmed feeding to manage young beef cows. J. D. Shockey*, P. A. Beck, P. Gregorini, C. B. Stewart, and S. A. Gunter, *University of Arkansas Division of Agriculutre, SWREC*, *Hope*.

On 10 November 2005, 52 non-lactating cows (BW = 434 ± 1.3 kg) of mostly Angus breeding were stratified by BCS, parity, BW, and distributed randomly into four 0.81-ha drylots. The cows were bred to calve in February 2006 for the first (n = 37) or second (n = 15) time. Cows in 2 pens were program fed a high-concentrate diet during 2 feeding periods, gestation (84 d) and lactation (56 d). The diet was fed in amounts to meet the cows' NEm requirements at each stage of production as described by the NRC (2000). The diet was formulated to be 12.1% chopped corn stalks, 67.8% hominy feed, 1.5% cottonseed meal, 2.3% minerals, 0.5% urea, and 15.9% water on an as fed basis (79% DM; 12.3% CP, 2.1 Mcal of NEm/kg [DM basis]). Cows in the other 2 drylots were fed long-stem bermudagrass hay (9.4% CP, 1.1 Mcal of NEm/kg [DM basis]) plus a hominy feed based supplement. Cow BW after the first 84 d tended ($P \leq 0.09$) to be improved by programmed feeding (430 kg) compared to hay feeding (474 kg); but no difference was noted ($P = 0.20$) after 56 d of lactation. Body condition score did not differ ($P \geq 0.36$) before calving, but BCS (9 point scale) was higher ($P = 0.05$) during lactation for program-fed cows (6.1) than hay fed (5.3). Total DMI was reduced 27% or more ($P < 0.03$) for cows that were program fed compared to hay fed cows during gestation and lactation. Program-fed cows had a pregnancy rate of 92% compared to 80% for hay-fed cows ($P = 0.37$; SE = 7.8). Milk samples were collected March 30 and May 11; percentage protein and fat did not differ ($P \geq 0.34$) between treatments. Calving date, calf birth weight, agility, vigor, and calving ease did not differ ($P \geq 0.42$) between treatments. On March 30, May 11, and July 6, calves from program-fed cows tended ($P \geq 0.14$) to be heavier than the

calves nursing hay-fed cows. These data suggests that calves nursing program-fed cows probably had a higher plain of nutrition and performed better than calves nursing hay-fed cows.

Key Words: Beef Cows, Programmed Feeding, Hominy

666 Performance of beef cows fed free-choice whole cottonseed and hay during winter. G. M. Hill*[1], M. H. Poore[3], M. E. Pence[2], and B. G. Mullinix, Jr.[1], [1]*University of Georgia*, *Tifton*, [2]*University of Georgia Vet. Diagnostic Ctr.*, *Tifton*, [3]*North Carolina State University*, *Raleigh*.

In a 2-yr experiment, beef cows were fed supplemental whole cottonseed [WCS; DM, CP, crude fat, (% DM), respectively, 92.2, 23.5, 17.8], and free-choice bermudagrass hay [DM, CP, NDF (% DM), respectively, 90.9, 10.2, 77.8] in hay rings on dormant pastures (n=6, 0.89 ha each). Non-pregnant cows (n=84, 42/yr) were of Breed Type 1 (BT1, Angus =32, Polled Hereford =9) or Breed Type 2 (BT2, Brangus=28, Braford=15). Cows were ranked by BW within BT, and randomly assigned to dietary treatments: Low WCS (LCS; 0.25 % initial BW); Medium WCS, (MCS; 0.5 % initial BW), and WCS fed free-choice (FCS) for 63d (2005) and 70d (2006). Initial and final BW were means of consecutive daily unshrunk BW. On d 1 and d 63 (2005), d 70 (2006), 13th rib ultrasound fat (UR, cm) and rump (URP, cm) were determined. Initial BW, cow age (CA), initial UR, and initial URP for 2005 and 2006, respectively, were: 517.4 ± 99.2, 578.9 ± 78.4 kg, $t = 3.15$, $P < 0.05$; 3.67 ± 1.87, 6.33 ± 2.88 yr, $t = 5.02$, $P < 0.01$; 0.60 ± 0.43, 0.78 ± 0.27 cm; 0.55 ± 0.61, 0.51 ± 0.22 cm, and these values were used as covariates. The DMI of WCS, hay and total diet (kg) on LCS, MCS, and FCS, respectively, were: 1.4c, 9.5b, 10.9b; 2.4b, 11.5a, 13.9a and 4.1a, 10.4ab, 14.4a; within WCS, hay or diet, means with uncommon letters differ ($P < 0.01$). The ADG for cows in 2006 was adjusted to 63 d, and the 2-yr 63-d ADG (Table) was higher for FCS. Cow UR and URP changes were greater in 2006 than 2005, and URP had greater positive changes for MCS and FCS than LCS. Positive changes in UR occurred for MCS and FCS, and negative changes for LCS. Cow ADG and UR were affected by BT × CA interactions ($P < 0.10$) with ADG (kg) and UR (cm), respectively, for CA < 3 yr at 0.44, 0.01 vs. 0.63, 0.07 for BT1 vs. BT2; and CA > 4 yr at 0.41, 0.12, vs 0.44, -0.02 for BT1 vs. BT2, SE 0.07, 0.05. Feeding WCS free-choice increased cow ADG, and MCS and FCS resulted in increased cow body condition.

Table 1.

Item	2005	2006	SE	P <	LCS	MCS	FCS	SE	P <
63-d ADG, kg	0.54x	0.43y	0.05	0.10	0.36r	0.45r	0.59q	0.04	0.05
UR change, cm	-0.06b	0.15a	0.04	0.01	-0.08s	0.07rs	0.14q	0.05	0.05
URP change, cm	0.01b	0.32a	0.05	0.01	0.04b	0.21a	0.25a	0.04	0.01

Key Words: Cow, Cottonseed, Ultrasound

667 Evaluation of NRC (1996) model energy requirement and DMI equation accuracy and precision for wintering beef cows in western Canada. J. L. Bourne[1], H. C. Block*[1], H. A. Lardner[2], and J. J. McKinnon[1], [1]*University of Saskatchewan*, *Saskatoon, SK, Canada*, [2]*Western Beef Development Centre*, *Humboldt, SK, Canada*.

Three years of winter feeding trials using 90 Angus cows (15 pens of six) fed typical wintering diets formulated to stage of pregnancy were used to evaluate NRC (1996) energy requirement and DMI equation accuracy and precision. Data collection included pen DMI, individual cow weights, body condition scores, calving dates and weights, and daily temperature and wind speed. Diet energy density was estimated from nutrient analysis of composited weekly feed samples. Equation evaluations compared observed and predicted DMI and conceptus corrected ADG for the second and third trimesters using regression, means comparison, concordance correlation coefficient (CCC), and total deviation index (TDI) methods. Across all three years, second trimester DMI was over predicted ($P<0.01$) with low precision (CCC = 0.24, 90% TDI = n/a) using actual environmental conditions, but not ($P=0.34$) when assuming thermal neutral (TN) conditions, although precision remained low (CCC = 0.25, 90% TDI = 1.91 kg/d). Third trimester DMI was also over predicted ($P<0.01$) with low precision (CCC = 0.12, 90% TDI = 1.57 kg/d) using actual environmental conditions, but was largely under predicted ($P<0.01$) with worse precision (CCC = -0.01, 90% TDI = 2.34 kg/d) when assuming TN conditions. Across all three years, second trimester ADG was largely under predicted ($P<0.01$) with low precision (CCC = 0.50, 90% TDI = 0.58 kg) using actual environmental conditions, but over predicted ($P<0.01$) with similar precision (CCC = 0.51, 90% TDI = 0.50 kg) when assuming TN conditions. Third trimester ADG predictions using actual environmental conditions were inaccurate ($P<0.01$) with low precision (CCC = 0.20, 90% TDI = 0.70 kg) and worsened (CCC = -0.01, 90% TDI = n/a) when assuming TN conditions where ADG was over predicted ($P<0.01$). These results indicate a lack of accuracy and precision with the current NRC (1996) model energy requirement and DMI equations that was not addressable by assuming TN conditions. Future research should be targeted at alternate DMI equations and refinements to maintenance and gain requirements.

Key Words: NRC Evaluation, Nutrient Requirements, Wintering Beef Cows

668 Improving fecal near-infrared reflectance spectroscopy predictions of botanical composition of ruminant diets. J. W. Walker*, B. S. Engdahl, E. S. Campbell, and C. J. Lupton, *Texas Agricultural Experiment Station*, *San Angelo, TX*.

Near infrared reflectance spectroscopy of fecal samples (FNIRS) can be used to predict the botanical composition of herbivore diets. FNIRS has been used to predict the percentage sagebrush, leafy spurge, and spotted knapweed in sheep diets; and juniper and leafy spurge, in goat diets. Calibrations were developed using fecal diet pairs from feeding trials where the percentage of the species of interest was known. Calibration statistics consistently show that useful calibrations can be developed. However, the results of independent validations show a loss precision and a considerable reduction in accuracy. The objective of this research is to conduct a meta analysis to determine the strengths and limitations of FNIRS for predicting botanical composition of herbivore diets. Independent validation statistics compared to calibration and cross-validation statistics indicate that the coefficient of variation is reduced by 30 – 50 percent and the bias is increased 2 – 4 fold. Predictions of samples that are different from calibration samples should be considered an interval scale of measurement. Microhistological estimates of botanical composition are less precise than independent validations, which limits the use of this technique as a standard analytical procedure. Predictions of botanical composition

are affected by the design of the feeding trial. Trials should include 4 or more different background forages and 4 levels of the target plant, including 0. Dried forages, even those species with high levels of volatile secondary plant compounds, appear to provide calibrations as accurate and precise as calibrations using fresh or frozen plant material. The addition of samples to the calibration equation from animals on the same base forage but with 0 levels of the predicted species as animals being predicted can improve the precision and accuracy of predictions significantly. Animal variables such as breed, sex and age can affect fecal spectra but not necessarily the prediction of the target plant.

Key Words: Goat, Sheep, Microhistological

Sheep Species: Biology and Management of Low-input Lambing Management in Easy-Care Systems

669 Genetic and physiological effects on maternal behavior and lamb survival. C. M. Dwyer*, *SAC*, *Edinburgh, UK*.

Failure in the development of the ewe-lamb bond has been implicated in 80% of lamb pre-weaning deaths. Increased shepherding inputs have been used to improve lamb survival. However, a better understanding of the ewe-lamb bond and applying management and genetic techniques to improve this relationship provide a sustainable route to reduce lamb mortality. Appropriate expression of maternal behavior by the ewe (licking the lamb, low-pitched bleating, udder acceptance) can be disturbed in primiparous ewes, and in ewes undernourished in pregnancy. In addition, using two breeds of sheep (Scottish Blackface, Suffolk), we have shown that significant variation exists between breeds in both the quality of maternal behavior (e.g. percent time spent licking lamb in 2 hours after lamb birth: Blackface = 60.7%, Suffolk = 43.8%, s.e.d. = 2.6%, $P < 0.001$), and lamb vigor (e.g. time to stand after birth (min, means with 95% confidence intervals): Blackface = 15.3 (12.1 to 19.4), Suffolk = 25.7 (20.3 to 32.6), $P < 0.001$). Embryo transfer between breeds demonstrates that these behavioral differences are intrinsic to the breed and are not influenced by partner behavior. The observed behavioral differences result in higher lamb mortality in the Suffolk breed compared to Blackfaces (14% vs. 3%, $P < 0.001$). Investigation of maternal physiology showed higher circulating concentrations of estradiol, and estradiol:progesterone ratio, in Blackface ewes in late gestation in comparison to Suffolk ewes (estradiol concentration (pg.ml): Blackface = 11.4, Suffolk= 7.9, s.e.d. = 0.9, $P < 0.001$), and estradiol concentration was correlated with maternal licking and low-pitched bleating ($r^2 = 20\%$, $P < 0.005$). These data suggest that genetic differences in maternal behavior in sheep may be mediated by variation in the physiological processes underpinning the onset of maternal care. In addition to breed differences in behavior, significant sire effects within breed exist for lamb vigor, and lamb behaviors are heritable ($h^2 = 0.15$ to 0.35). Taken together these data suggest there is considerable potential to improve lamb survival by selection and management to improve ewe maternal behavior, and by genetic selection for lamb vigor.

Key Words: Maternal Behavior, Neonate Survival, Sheep

670 Management of maternal-offspring behaviour to improve lamb survival in low input systems. J. Everett-Hincks* and K. Dodds, *AgResearch*, *Invermay Agricultural Centre, Mosgiel, Otago, New Zealand*.

This paper provides an investigation into the environmental and management effects on lamb survival on high performing sheep farms in New Zealand. Improved lambing percentage is the biggest contributor to higher profits on New Zealand sheep farms. Many sheep breeders have selected and bred ewes for increased fecundity over the last four decades. Lamb survival is an important issue in highly fecund sheep flocks. The increased proportion of ewes having triplets is of concern to farmers and to industry as lamb mortality in the 24 hours post-partum is highest in triplets. The majority of lamb deaths occur in the first three days after birth and range from 5 to 30% for individual sheep flocks. These losses are unacceptable from animal welfare and production perspectives. The ability of a lamb to survive to weaning is determined by the successful execution of a number of processes. These are driven by genetics, behaviour, physiology and the environment, including on farm management practices. This study investigated the effects of dam body condition in pregnancy, weather over lambing, lamb birth weight and maternal behaviour on single, twin and triplet lamb viability at birth and survival through to weaning for 24 industry flocks (28525 lambs; 3474 singles, 18510 twins, and 6541 triplets) from 2003 to 2005. Ewes with higher body condition scores in mid pregnancy had heavier lambs at birth. Lambs weighing 6 to 8 kg at birth were more likely to be viable at birth and survive to weaning than heavier or lighter lambs. Weather conditions during late pregnancy proved as important as conditions during lambing in determining lamb viability and survival through to weaning. Older ewes and ewes with triplets require considerably more attention for farmers to realise their production potential. This paper explores the effect of environmental and management factors on lamb birth weight and survival and uses this information to formulate appropriate management programmes to improve lamb survival rates under low-input farming systems.

Key Words: Lamb Survival, Management, Sheep

671 Evaluation of Dorper, Dorset, Katahdin, and Rambouillet crossbred ewes in high- and low-input production systems. K. A. Leymaster*, *USDA-ARS, U.S. Meat Animal Research Center*, *Clay Center, NE*.

The primary objective was to evaluate wool (Dorset, Rambouillet) and hair (Dorper, Katahdin) dam breeds for their ability to complement Romanov germplasm as crossbred ewes managed in distinct production systems. Romanov ewes were mated with 18 rams of each dam breed to produce crossbred ewes for evaluation through 3 yr of age in two production systems. In the high-input system, labor and harvested feed were provided for sheep in confinement facilities and ewes were limited to rearing two lambs with additional lambs reared artificially. Ewes in the low-input system lambed on pasture and were responsible for rearing all lambs. No labor or supplemental feed were provided before weaning. A total of 830 crossbred ewes produced 1,962 litters and 4,171 lambs from 2,172 multisire exposures to two terminal sire

breeds (Suffolk, Texel). Fertility rate (FR), number born (NB), lamb losses between birth and 24 wk (LOSS), number at 24 wk (N24), and 24-wk litter weight (LTRWT) were analyzed as a trait of the ewe. Effects of year of birth, dam breed, production system, sire breed, ewe age and their two-way interactions were estimated. Random effects of sires of crossbred ewes and repeated effects of ewes across ages were fitted. Ewe age affected all traits and often interacted with dam breed and production system ($P < 0.05$). The interaction of dam breed x sire breed on FR ($P < 0.05$) was due to change in rank as well as magnitude. Suffolk-sired litters had greater LOSS and lesser N24 than litters by Texel rams ($P < 0.05$). Interactions of dam breed with production system were not detected. The high-input system had greater ($P < 0.05$) values than the low-input system for NB, N24, and LTRWT24 and approached significance for FERT and LOSS. Main effects of dam breed were detected ($P < 0.05$) only for NB and N24, with Katahdin crossbred ewes producing the most lambs, followed by Dorset and Dorper and then Rambouillet. Other key traits need to be considered before use of these dam breeds is recommended.

Key Words: Production Systems, Hair Breeds, Sheep

672 Pasture lambing prolific sheep. J. W. McNally*, *Tamarack Lamb & Wool*, *Hinckley, MN*.

Since the 1960s most Midwestern farm flocks have adopted an intensive sheep management system that entails winter lambing inside a barn. While this system has become very specialized, the high labor requirement of winter lambing, and the high cost of lambing indoors has meant most farm flocks have remained rather small and insignificant in financial contribution. Most flock owners responded by pushing lambing rates higher with a corresponding assumption that prolific sheep require extra care and attention that can only be afforded by lambing indoors. Tamarack Lamb & Wool added the Booroola *Fec*B gene to Dorset ewes in 1987 through selective crossbreeding, resulting in a lambing rate of 240 to 280% in ewes that carry the *Fec*B gene. Previously a fall and winter lambing flock, the flock was moved to late spring pasture lambing to accommodate the growing numbers of sheep. The benefits of lambing on pasture included better milk production and greater newborn survival, lower labor, considerably lower input costs, and the ability to run much larger numbers of sheep limited only by the forage resources that could be fenced. The core management considerations for pasture lambing are: 1) proper timing of lambing to synchronize with lactation quality feed and reasonable weather; 2) proper management of forage resources; 3) suitable animal genetics; and 4) minimal disturbances in the lambing paddock such as dogs, people, predators, first time mothers, or supplementary feeding. Tools used to manage feed and animals include 1) use of drift lambing; 2) set stocking after lambing; 3) rotational grazing; and 4) use of high energy tillable crops for fall finishing. Pasture lambing requires education of both sheep and shepherd. A new set of stock handling skills are required from the shepherd, and sheep can take several years to unlearn their barn lambing habits. Over the past 16 years the system used at Tamarack Lamb & Wool has been so successful that it has remained remarkably the same. The greatest change has been to relax the labor requirement as the sheep have become increasingly proficient at rearing lambs on pasture.

Key Words: Management, Lambing, Sheep

673 What does it mean to be locally adapted and who cares, anyway? F. D. Provenza*, *Utah State University*, *Logan*.

Sustainability is about ongoing adaptation in ever changing environments. What might that mean in the 21st Century? In ″The Long Emergency″ Jim Kunstler argues the availability of fossil fuels will decline severely in the first half of the 21st Century, and the massive deficits won't be countered by alternative sources of energy. This seeming catastrophe will create opportunities as communities come to rely on foods locally produced. Agriculture will be at the heart of communities, but its lifeblood won't be fossils to fuel machinery or fertilizers, herbicides and insecticides to grow and protect plants in monocultures, antibiotics and anthelmintics to maintain the health of herbivores, or nutritional supplements and pharmaceuticals to sustain humans. Rather, from soils and plants to herbivores and people we'll learn what it means to be locally adapted. Plants will be used as nutrition centers and pharmacies, their vast arrays of primary (nutrients) and secondary (pharmaceuticals) compounds useful in nutrition and health. Animals will be locally adapted to landscapes where they'll live from conception to consumption. Livestock will be produced in easy-care systems that match their production needs with locally available forages, and that involve an ongoing dialog among genes, social and biophysical environments, one that causes neurological, morphological and physiological changes in utero and early in life and confers survival advantages as the environment of rearing matches the environment where animals then live. Historically, the likelihood of a match was high as animals were conceived, reared, and reproduced in the same environment, and the strong fidelity animals' show to the sites where they are reared ensures they are locally adapted. Fossil-fuel subsidized management practices have created mismatches by requiring mother and offspring to be separated early in life and offspring to live in environments different from where they were conceived and reared. In this century, we will of necessity create easy-care ecosystems that nurture relationships among soil, water, plants, herbivores and people to sustain their collective wellbeing.

Key Words: Sustainability, Adaptability, Profitability

Teaching/Undergraduate & Graduate Education: Teaching Session I - Assessment & Evaluation

674 Evaluation and accreditation of agricultural research and teaching programs. J. R. Swearengen*, *AAALAC International*, *Frederick, MD*.

Considerable misunderstanding still exists regarding the process which AAALAC International uses for accrediting agricultural research and teaching programs. The objective of this presentation is to clarify the methodology used by AAALAC International to evaluate agricultural programs. It will include a review of the standards used by AAALAC International for evaluating the program of animal care and use specifically for agricultural programs and walk through the process of how a site visit is conducted. Specific examples of what is expected from both facility and programmatic perspectives will also be presented. This review will include a look at common physical plant issues such as barns, fences, pastures and paddocks and programmatic issues such as farrowing crate size, winter calving, and extension sites. With increasing scrutiny from the public sector on issues of animal well-being in production agriculture and agricultural research and teaching, the ability to demonstrate sound animal care will continue to grow in importance. AAALAC International accreditation is a confidential, external peer-review system utilizing experts in the fields of agricultural research and teaching. Accreditation not only provides for public accountability, but also establishes a quality assurance mechanism which emphasizes performance standards and peer review. These benefits, as well as others, will be discussed as they apply to agricultural programs. Having a full understanding of the AAALAC International accreditation process as it pertains to agricultural research and teaching will help attendees make informed decisions about the need and value of accreditation for their programs.

Key Words: Accreditation, Agricultural, Research

675 Development and use of a learning outcomes based assessment tool. J. L. Beckett*, *California Polytechnic State University*, *San Luis Obispo*.

Both universities and accrediting agencies are increasing efforts directed toward assessing the degree to which students are learning and the effectiveness of educational programs. However, assessing learning is a challenging and multi-layered task. Well defined and measurable learning outcomes assessment tools can facilitate the process and make it more useful and meaningful. At Cal Poly, a software program has been developed to create the learning outcomes process, print rubric scoring tables, data collection sheets, track and analyze data and print reports. A 4-point rubric scoring system (outstanding, proficient, approaching proficiency and needs improvement) was developed for assessing student learning along with criteria to categorize student work into those 4 proficiency levels. Questions embedded in final exams of capstone courses have been the primary artifacts used for assessment. Because several (36) learning outcomes have been defined and it is not appropriate, practical, or even desirable to assess all artifacts for all learning outcomes each time assessment is conducted, a flexible rubric scoring system was developed to rapidly create individualized rubric scoring sheets for assessing the specific learning outcomes to be evaluated in each set of artifacts. Additionally, a system for data collection was developed, including standard operating procedures. A data tracking system was created to simplify data entry and promote ease of data analysis and tracking. Because learning outcomes are aligned with programmatic, College and University objectives, data can be mined for trends by learning outcome, or by any combination of learning objectives. With these tools, faculty time is used effectively and the assessment coordinator can quickly and efficiently prepare for each assessment event, summarize the data, and expeditiously provide results to the faculty for rapid feedback and evaluation. By engaging faculty in the assessment process and using tools to simplify the assessment procedures, implementation of meaningful assessment has been put in place to provide guidance in curriculum development and ultimately enhance student learning.

Key Words: Education, Assessment, Learning Objectives

676 Assessment of predictors of critical thinking ability in animal science undergraduates. L. M. Morgan*, *Clemson University*, *Clemson, SC*.

Critical thinking and independent decision–making are essential for graduates seeking employment. Previous research shows that seniors in a college of agriculture scored lowest on a critical thinking ability construct, and higher on basic cognitive ability and applications ability constructs. Multiple predictors have been studied to identify their influence on critical thinking ability. Possible factors studied have included: age, gender, GPA, learning style, and classification. Therefore, the focus of this study was to quantify the critical thinking ability of students in selected classrooms in an animal science department and determine what demographic information served as a reliable predictor of critical thinking ability. The Watson–Glaser Critical Thinking Appraisal (WGCTA) test, form A and B, from Harcourt Assessment provided means to objectively assess a student′s critical thinking ability. The WGCTA seeks to provide an estimate of an individual′s standing on a composite of attitude, knowledge, and skills by means of evaluating the student′s ability to think critically in five categories: 1) Inference; 2) Recognition of Assumptions; 3) Deduction; 4) Interpretation, and 5) Evaluation of Arguments. Categories are weighted equally and final score is on a 0–80 scale. Each student (n=90)completed a questionnaire to determine demographic information with respect to: age; gender; classification; GPA, and previous judging experience. All data were analyzed for mean and standard deviation of final scores. Raw scores were then standardized and compared using a z–score. Mean score was 58.4 and standard deviation was 7.00. Multiple indicators for critical thinking ability were observed; students in the 18–20 age range (n=42), those who reported ≥3.4 GPA (n=26), and those who had experience judging in 4H and on a competitive judging team (n=3) scored higher than 87% of all students tested. Classification does not appear to influence critical thinking ability. Age, GPA, and previous judging experience do appear to predict critical thinking ability.

Key Words: Critical Thinking, Watson-Glaser

677 Critical thinking dispositions of undergraduates in two animal science courses at the University of Georgia. T. D. Pringle*, J. L. Douglas, and J. C. Ricketts, *The University of Georgia*, *Athens*.

Students in two University of Georgia (UGA) Animal Science (AS) courses were utilized to evaluate the critical thinking disposition (CTD) of a sub-population of UGA undergraduates and to compare CTDs across two courses taught using different teaching methods. Fall semester 2006 students enrolled in the Introduction to Animal Science (ADSC 2010; n=71) and Live Animal and Carcass Evaluation (ADSC 3200; n=18) courses were asked to complete a CTD Assessment (UF-EMI) at the beginning of the semester and a modified UF-EMI at the end of the semester, which included a retrospective and a current assessment. Students were asked to respond to 26 prepared statements using a 5-point scale (1=strongly disagree to 5=strongly agree). Responses to the statements were divided into three constructs. Engagement (E) which measures students' predisposition to searching for opportunities to use reasoning, anticipating situations that require reasoning, and confidence in reasoning ability; cognitive maturity (M) which measures predisposition to being aware of the complexity of problems, being open to other view points, and being aware of their and other's biases and predispositions; and innovativeness (I) which measures predisposition to being intellectually curious and having a desire to know the truth. Data were analyzed using SPSS, with $P<0.05$ used for significance. At semester's beginning, standardized and summated mean scores for E, M, I and total disposition were 79.27 (43.60), 77.97 (31.19), 80.15 (28.05), and 79.07 (102.79), respectively. Across all categories, UF-EMI scores were higher at the end of the semester than at the beginning. Change in UF-EMI was higher for students in the upper level ADSC 3200 course than the ADSC 2010 course. While AS majors had lower UF-EMI scores than non-majors, AS majors had greater UF-EMI gains in all constructs. Lastly, year in school did not result in differences in UF-EMI scores, while surveyed females scored somewhat higher than males. These data provide a snapshot of the CTD of UGA AS students and suggest that hands-on, experiential learning courses are important to the CT development of AS students.

Key Words: Critical Thinking, Disposition

Teaching/Undergraduate & Graduate Education: Teaching Session II - Curricular Innovation

678 Food Animal Scholars Program: An early selection program for undergraduates at North Carolina State University interested in pursuing a career in veterinary medicine working with food animals. W. L. Flowers*, C. R. Parkhurst, J. A. Moore, C. S. Whisnant, S. L. Pardue, and C. M. Williams, *North Carolina State University*, *Raleigh*.

The College of Agriculture and Life Sciences (CALS) and the College of Veterinary Medicine (CVM) at North Carolina State University developed a program to identify and prepare students for careers in food animal medicine. The program began in 1992 and was called the Swine and Poultry Scholars program. Initially, one student interested in swine and one in poultry were selected during the first semester of their freshmen year by a committee of CALS and CVM faculty. Students were chosen on the content of an essay and recommendations. Those selected were guaranteed admission to the CVM after completing their undergraduate degree in either Animal or Poultry Science provided they met all the minimum qualifications required including minimum GPA and extracurricular requirements. Each scholar was assigned two mentors – one in CALS and one in the CVM. Responsibilities of the mentors involved meeting with the students to monitor academic progress and provide extracurricular opportunities for them to interact with veterinarians and researchers in the swine and poultry industries. Upon admission into the CVM, there was no binding commitment for students to specialize in food animals. In 2003, the program was expanded to include 6 recipients and 2 alternates with an interest in any of the food animal species and renamed the Food Animal Scholars Program. Selection of students was moved to the second semester of their sophomore year. Participation in extracurricular activities with food animals and GPA were included in the selection criteria. The mentoring program remained basically the same and students were required to enroll in the food animal track upon entry into the CVM. Between 1994 and 2003, only 28% (4/14) of the Swine and Poultry Scholars selected have completed (or are in the process of completing) the program and either are working (or intend to work) with food animals upon receiving their DVM. Since the changes implemented in 2003, 73% (16/22) of the Food Animal Scholars are still in the program.

Key Words: Teaching, Veterinary Medicine

679 Design and development of a synchronously-delivered graduate course designed for the evaluation and practice of scholarship in animal sciences. L. A. Kriese-Anderson[1] and D. R. Mulvaney*[1,2], [1]*Auburn University*, *Auburn, AL*, [2]*Biggio Center for the Enhancement of Teaching and Learning*, *Auburn, AL*.

The professional life of academics is highly dependent on effective scholarship and the ability to evaluate publications for credibility. Often times, graduate programs rely heavily on transfer of scholarship skills from major professors. Built on a premise that there is a need by graduate students for development of these skills early in their career, our objective was to design and pilot a masters level graduate course targeting learning outcomes of increased awareness, knowledge and skills around scholarship to include proficiency in: conducting literature searches, evaluating research, scientific literature, writing technically for grant proposals as well as writing to transform technical scientific findings into more simplified forms of scholarship appropriate for various and broadened audiences. The course established concepts of working in a learning community (LC) and employed discussion of philosophies of scholarship, methods of research, evaluation of scientific writing, evaluation and practice of written proposals for funding and the process of publishing research findings. The course was delivered synchronously using videoconferencing technologies. Each of the eleven students played a pivotal role in professionally researching facts about writing and evaluating literature and preparing this information for others in the class. Students considered themselves members of a LC thus taking ownership and then chose to energetically and actively, bring learning opportunities to other members of the LC.

Selected formative and summative evaluation rubrics were developed to assess learning outcomes. A five point scale was applied to a 33 question pre- and post-course survey of knowledge or abilities around scholarly practices. Post-course responses increased by 2 points for most survey questions allowing a conclusion that the course was relevant and appropriately designed to meet student needs.

Key Words: Graduate Students, Scholarship, Animal Sciences

680 The value of writing to a real-world audience for animal science students. M. W. Orth*, *Michigan State University*, *East Lansing*.

For most writing assignments, the students' target audience is a professor, an individual who will be highly knowledgeable and trained in the subject matter of the written work. However, upon graduation, students will communicate with people from a diversity of backgrounds. An assignment was designed to have students in Growth and Musculoskeletal Biology (a junior-senior level animal science course) write to a much younger audience relative to a university professor. Students were asked to read 2 papers from *Nature* on bone metabolism and then write a one-page summary describing bone turnover to high school sophomore biology students using an age-appropriate vocabulary. A first draft was submitted, critiqued, and returned for revision. The final draft was collected, copied, and given to students at a local high school to read during their class period. These students critiqued the papers and filled out an evaluation on how well they understood bone turnover after reading the paper. Questions in the evaluation included ″Were there words in the paper that you did not understand? If so, please write them down" and "Based on the paper you just read, write down what you believe are the three most important processes involved in replacing old bone with new bone″. They were also asked to recommend a grade. The writing exercise is good for college students because they must translate technical biological concepts into language that typical teenagers can comprehend. As a side note, the two years the college students have done this assignment, the average grades have been higher on the quiz covering bone metabolism relative to the year before the assignment was initiated (80% and 91% vs. 76%). Thus, this assignment may be helping them better understand bone metabolism. The high school students enjoyed reading and grading the papers and took it quite seriously. Their suggested grades generally reflected the quality of the written work. Writing projects like this can facilitate the students' comprehension of a subject and prepare them for communicating to different audiences.

Key Words: Writing, Communication, Bone

681 Tracking undergraduate student performance while learning molecular genetics concepts. B. S. Walters* and T. J. Buttles, *University of Wisconsin*, *River Falls*.

This Scholarship of Teaching and Learning (SoTL) project documented students' understanding of the molecular genetics concepts that form the heart of modern biotechnology. The project studied animal, plant, and food science majors in three semesters of an agricultural biochemistry course. It is a 200 level class made up of sophomores through seniors with 50-60 students enrolled each semester. The starting point was to determine students' experience in related courses and level of prior understanding. As a pretest, students were asked to complete a short questionnaire containing questions on related courses and defining 5 terms. Two additional data collection points were utilized. A quiz on DNA structure and types of RNA was given during the unit. The second course exam included questions on DNA and protein synthesis. For data analysis students were grouped based on the related courses completed and in-progress. Mean pretest scores, change from quiz to exam, and change from pretest to exam were calculated. Because of the wide variation across semesters each class was treated as an individual case. The largest group of students (44% - 56% each semester) had completed both introductory biology and genetics classes. The second largest group (17% - 21%) had completed both introductory biology and genetics while taking animal or plant breeding concurrently with biochemistry. The third largest group (9.6% - 17%) had completed introductory biology while taking genetics concurrently with biochemistry. Mean pretest scores ranged from 16% - 36% for group 1, 18% - 30% for group 2, and 10% - 27% for group 3. The mean improvement from quiz to exam on the DNA structure questions ranged from 14% - 32% for group 1, 10% - 50% for group 2, and -17% - 49% for group 3. The mean improvement from quiz to exam on the protein synthesis questions ranged from 30%- 32% for group 1, 24% - 49% for group 2, and 9% - 23% for group 3. The mean improvement from pretest to exam on the protein synthesis questions ranged from 45% - 66% for group 1, 49% - 69% for group 2, and 38% - 62% for group 3.

Key Words: Undergraduate Education, Teaching, Biotechnology

682 Bringing the industry into the classroom: Media interview project. J. A. Sterle*, *Texas A&M University*, *College Station*.

Twenty-one undergraduate students (18 freshmen, 2 sophomores, 1 senior; 18 females and 3 males) were enrolled in ANSC 107: General Animal Science – Honors Section. In comparison to previous years, most students were not Animal Science majors nor did they have an agricultural background. Students randomly drew one of 11 topics and were given a specific scenario unique to their topic on a later date. Topics included: Use of hormones as growth promotants, the Horse Slaughter Prevention Act, Arizona Proposition 204: Use of sow gestation stalls, use of antibiotics in livestock, and animal well-being. Students were required to research the topic, including opposing views, and write a six to ten page paper on the issue. Three weeks after receiving the scenarios, students received media training from National Pork Board′s Operation Main Street program. Students prepared message points and were then interviewed by a media professional and videotaped. Students were given a short survey to complete anonymously. Eighteen of 21 students returned the survey (85.7%). The following Likert scale was used: 1 = very uncomfortable; 2 = slightly uncomfortable; 3 = neither comfortable or uncomfortable; 4 = fairly comfortable; 5 = very comfortable. Results are presented in Table 1. Students were also asked about perceived change in level of knowledge about current issues facing animal agriculture. Response average was 4.67 with 1 = none; 2 = a little; 3 = some; 4 = quite a bit; 5 = a tremendous amount. These results indicate that students′ perceived knowledge level of current issues and level of comfort with speaking in various situations increased by completing this project.

Table 1. Response of students when asked about comfort level of speaking in different situations.

How comfortable were you with:	Prior to project	After project
Public speaking overall	2.67	3.72
Speaking in front of peers	3.39	4.33
Speaking with the media	1.83	3.50
Speaking in front of large groups	1.94	2.88
Discussing issues facing animal agriculture	2.17	4.06

Key Words: Teaching, Media, Issues

683 Development of time-enhanced internet-based distance education in feed mill management and feed formulation. P. R Ferket*, *North Carolina State University*, *Raleigh*.

Availability or access to feed science programs at land-grant Universities is limited and does not supply feed industry employment demand. The average number of employees at feed plants decreased by 33% from 2000 to 2005, and few employees can take leave for training in priority matters such as regulatory compliance, feed safety, quality assurance, and worker safety (Gill, 2006). Using WebCTVista™ (http://vista.ncsu.edu), a course entitled ″Feed Mill Management and Feed Formulation (PO425-601)″ was developed and delivered to distance education students during 6 consecutive semesters. This 3-credit hour course included 4 learning modules: 1) feed industry, mill design, and management; 2) manufacturing and process control; 3) regulations and quality control; and 4) formulation and product development. Each module included virtual lectures (image-enhanced text, audio, and video), interactive self evaluation, discussion boards, creative assignments, and exams. Enrollment data and learning performance and evaluations of students enrolled in PO425-601 was compared to the on-campus section of the same course (PO425-001). Average annual enrollment in PO425-001 was 17 students, but the addition of PO425-601 increased enrollment to 41 and 44 students in 2005 and 2006, respectively. The 601 section was preferred by about 80% of the PO425 enrollment, and half were full-time feed industry employees. Average final grade and performance distribution were similar between sections 001 and 601. Overall course evaluation score (out of 5) from students enrolled in sections 001 and 601 were 4.56±0.53 and 4.0±.75, respectively. The use of the internet was found to be an effective and feasible teaching method to deliver highly technical information to students with time and travel limitations, such as those employed by the feed industry. Sequel distance education courses (″Advanced Feed Mill Operations and Management″ and ″Feed Quality Assurance and Formulation″) are being developed based on the model of PO425-601 to complete a certificate or minor degree program.

Key Words: Feed Mill Management, Distance Education, Internet Technology

684 The fundamentals of collegiate poultry judging. J. C. Butler* and P. A. Curtis, *Auburn University*, *Auburn, AL*.

Collegiate poultry judging is a powerful recruiting tool for a department and can also be an excellent way for undergraduates to interact and explore potential options for graduate school. Every year two collegiate contests are held, the National Collegiate Poultry Judging contest at the University of Arkansas and the US Poultry and Egg National Poultry Judging contest at Louisiana State University. In 2006 twelve universities competed for the national title, half of which have a strong poultry program. Several factors that may influence a school's decision to start a judging program include the willingness of a professor to provide leadership, availability of space on the farm for rearing and holding birds, funding and student interest. For those schools willing to make the necessary commitments, the judging team experience can be an excellent recruiting instrument. Our goal at Auburn University is to appeal to high school seniors and incoming freshman who currently utilize technology in their day-to-day social networking. In an effort to adapt to the learning practices of digital natives we have incorporated technology in Auburn University's inaugural poultry judging class. A unique approach to this experience at Auburn University is the use of technology as a teaching enhancement. A DVD was created which allows the students to see inside the hen and see the how the egg is formed This DVD entitled, "The Virtual Chicken: The Female Reproductive Tract," is used as an introduction to the egg quality judging experience. This DVD shows how defects such as blood spots and body checks occur. IPods are made available to students who do not currently own one. In addition, short podcasts have been developed for study tools to use outside the classroom. The podcasts provide the students with the basics they need to know for each judging ring. Technologies being utilized in this class may be of interest to other universities offering this course. Samples of these technology enhancements will be shown during the presentation.

Key Words: Collegiate Poultry Judging, Recruiting, Education

Wednesday, July 11, 2007
POSTER PRESENTATIONS

Animal Behavior & Well-Being - Livestock and Poultry III

W1 Laying hens in conventional and enriched cages. G. B. Tactacan*, J. D. House, and W. Guenther, *University of Manitoba*, *Winnipeg, MB, Canada*.

Concerns regarding the welfare of laying hens raised in battery cages have led to the development of enriched cages that allow hens to perform natural behaviors including nesting, roosting and scratching. This study was conducted to compare indices of production and welfare in birds housed in two different caging systems. Shaver White hens were housed from 21 to 45 weeks of age in either conventional battery cages (n = 500; 5 hens/cage; floor space = 87.1 in^2/hen) or enriched cages (Hellman; n = 480; 24 hens/cage; floor space = 99.6 in^2/hen). Enriched cages were provided with a nest, scratch pad and perches. Egg production, incidence of cracked, dirty or soft shelled eggs were recorded daily throughout the experiment. Feed consumption, egg weight and specific gravity were monitored at the end of every 28-d period. Plumage condition was evaluated on the neck, breast, back, tail, vent and wing regions at 35 weeks. Data were analyzed using t tests. The type of cage did not affect the hen-day egg production, feed consumption or egg weights. No significant differences were observed in specific gravity, percentage of cracked and soft shelled eggs between conventional and enriched cages, however, the incidence of dirty eggs was significantly higher ($P < 0.05$) in enriched cages (Enriched = 10.59% ± 2.95; Conventional = 3.78% ± 0.84). Plumage condition of the wings and back region of birds reared in the conventional cages were significantly higher ($P < 0.05$) and lower ($P < 0.05$), respectively, compared to birds reared in the enriched cages. All other body regions did not show significant differences. Overall, laying performance, egg quality measures and plumage condition appear to be similar for hens housed in the two cage systems tested.

Key Words: Laying Hen, Conventional, Enriched

W2 Evaluation of weight shifting as a pain indicator in lame pigs. L. Anil*, S. S. Anil, J. Deen, S. V. Westen, and S. K. Baidoo, *University of Minnesota*, *St. Paul*.

Lameness is a putatively painful condition, common in pig farms. Generally, both pain and lameness in animals are assessed subjectively, often anthropomorphically. An objective measure to assess lameness and the level of pain in lame pigs is necessary to evaluate pain alleviating interventions in lame pigs. The objective of the present study was to evaluate weight shifting as an objective indicator of pain in lame pigs. An analgesic was used in this study on the assumption that if analgesia could improve the condition it was pain that the animal was experiencing. This preliminary study involving 15 pigs was conducted at the swine research unit of the University of Minnesota at Waseca, MN. Visibly lame pigs were made to stand on slatted floor (12.7 cm solid portion and 2.54 cm slot) and on rubber mats (1.9 cm thickness) and number of weight shifting per minute was recorded. Subsequently the same pigs were treated with an analgesic (Flunixin meglumine 2.2 mg/kg body weight, intra-muscularly) and the number of weight shiftings per minute was recorded on both floor types 45 min after the injection. The measurements were repeated three times on alternate days with the same pigs during a continuous 5 days period. Within each floor type category the number of weight shifting before and after analgesic treatment were compared (Wilcoxon signed rank test).Similarly, the number of weight shifting before and after analgesic treatment was compared (Wilcoxon signed rank test) between floor types. The results indicated a higher ($P \leq 0.05$) number of weight shifting on slatted floor prior to analgesic treatment compared to post analgesic treatment, whereas the number of weight shifting on rubber mat were similar before and after analgesic treatment. Both before and after analgesic treatment, the number of weight shifting was lower on rubber mat compared to slatted floor ($P \leq 0.05$ for both). The study indicated that weight shifting may be considered as an objective indicator of the level of pain in lame pigs.

Key Words: Lameness, Pig, Pain

W3 Development of a feed-restriction model to identify factors responsible for fescue toxicosis-induced reduction in food intake. S. Raney*, P. A. Eichen, and D. E. Spiers, *University of Missouri*, *Columbia*.

Fescue toxicosis is caused by consumption of ergopeptine alkaloids produced by an endophytic fungus (Neotyphodium coenophialum) in tall fescue, and is characterized by reduced productivity. The primary contributors to the reduced productivity are decreased feed intake and growth. There have been few attempts to characterize these changes in performance. A study was conducted to develop a model

for this component of fescue toxicosis using rats in a feed restriction experiment described previously by others. Each animal was trained over a minimum 11 d period to eat their entire daily ration from 1300 to 1500. The advantage of this approach is that one can effectively evaluate the effect of potential treatments more precisely over a 2-h period than over 24 h. Group I animals were first fed ad libitum an endophyte-free seed (E-) diet, then restricted E- diet, then restricted endophyte-infected seed (E+) diet, and lastly ad libitum E- diet. There was no significant decrease in feed intake ($\alpha = 0.05$) from restricted E- diet to restricted E+ diet, but reduced growth while on E+ diet. Return to E- diet restored growth rate. A different routine was used with Group II. Rats were first fed ad libitum ground commercial diet, followed by restricted ground diet, then restricted E- diet, and lastly restricted E+ diet. Initial exposure to restricted diet decreased feed intake and growth rate ($\alpha = 0.05$), followed by partial recovery or adaptation over the next 4 d. Shift to restricted E- produced no change in feed intake and a greater return of growth rate. Restricted E+ diet intake reduced feed intake and growth rate within 24 h ($\alpha = 0.05$). This reduction was stable over the entire 2 week period. These responses agree with previous studies using long-term ad libitum E+ treatment. This new model can now be used to identify mechanisms for fescue toxicosis-induced reduction in feed intake and growth, and develop potential treatments.

Key Words: Fescue Toxicosis, Feed Intake, Rat

W4 Assessing the performance of Redbro Cou Nu chickens in different environments. W. L. Willis[1], M. Johnson[1], C. Hatcher*[1], and R. Joyce[2], [1]*North Carolina Agricultural and Technical State University*, *Greensboro*, [2]*Joyce Foods, Inc.*, *Winston Salem, NC*.

An experiment was conducted to evaluate feed type, placement time and density on the production performance of the Label Rouge chicken. Five hundred four day of hatch Redbro Cou Nu chickens were weighed, randomly assigned to two placement densities (1.0 sq ft vs 2.0 sq ft), replicated four times with 30 or 60 chicks per floor pen, with two pens for each density fed a convention or organic starter/grower diet for 9 wks, and two groups of 72 chicks housed for 3 or 6 wk for placement on pasture. Chicks were weighed weekly, mortality recorded daily, and feed consumption measured at the end of the trial. Body weights at 9 wks of age for the conventional feed and two placement densities were very similar (2.580 vs 2.540 kg) whereas, the organic chickens with more space had higher weights (2.720 vs 2.540 kg), respectively. Birds given 1 sq ft of space consumed less feed for both conventional and organic treatments. Chickens placed on pasture at 6 wks had higher body weights (2.373 vs 2.274) when compared to the 3 wk placed chickens. Mortality for the indoor chickens was similar and very low for both treatment groups. The chicks placed outside at three weeks suffered greater losses from hawks than the six wk placement group. The orientation of the house to the hawk's perch site is believed to have influenced the early placed chicks' susceptibility. The results from this study showed that not much production advantage is gained by the expensive organic feed and placement density indoors and placement time outdoors influence production parameters.

Key Words: Redbro Cou Nu Chickens, Placement Density, Organic Feed

W5 The effect of mushroom and pokeweed extract on *Salmonella* in molting hens. W. L. Willis*, O. Isikhuemhen, I. Goktepe, M. Reed, and C. Murray, *North Carolina Agricultural and Technical State University*, *Greensboro*.

The present investigation was conducted to evaluate the effects of mushroom and pokeweed extract in the drinking water of leghorn laying hens during a 10 d molting period. The trial consisted of 54 Single Comb White Leghorn hens approximately 77 wks of age. The layers were subjected to one of nine treatment (trt) groups, replicated three times with two hens per replicate cage. The treatments consisted of 1) Full-fed + H20; 2) Full-fed + mushroom; 3) Full-fed + pokeweed; 4) Non-fed molt + H20; 5) Non-feed molt + mushroom; 6) Non-fed molt + pokeweed; 7) Full-fed alfalfa meal + H20; 8) Full-fed alfalfa meal + mushroom and 9) Full-fed alfalfa meal + pokeweed. The pokeweed extract showed antimicrobial activity against Salmonella spp. in the crop ranging from 5-20 % of the initial control. Hens treated with crude pokeweed extract and no feed had the highest reduction in Salmonella spp. count. There was a reduction of Salmonella spp in alfalfa + mushroom (2.6 log 10) when compared to the non-fed + mushroom (2.8 log 10) and the Full-fed + H20 (2.9 log 10). The level of Salmonella spp. in the ceca of hens subjected to fasting exceeded 3.0 log10 in trt 4, whereas the alfalfa mushroom combination showed a lower level of 2.7 log 10. *Salmonella enteritidis* was isolated from the ovary and spleen (66%) in trts 2, 3, and 9, but not in the liver of any trt's. Egg production lagged behind more in trt's 8, 9 and 5, respectively, than any other treatments. No differences were noted in body or organ (liver, spleen, ovary) weight reduction between treatments. These results indicate that pokeweed and mushroom extracts exhibits antimicrobial activity against Salmonella spp. and such activity are expected to increase with higher concentration of extracts.

Key Words: Laying Hens, Molting, *Salmonella*

W6 Control of feral hog populations: a domestic pig model to attract and repel feral hogs using odors. N. Krebs, L. E. Hulbert*, and J. J. McGlone, *Texas Tech University*, *Lubbock*.

Controlling feral hog populations is important to farmers and communities because of economic and health concerns. Traps work better if an attractive substance such as corn is present. The aim of this study was to determine which odors were attractive or repulsive to feral hogs, using a domestic pig model. Weaned pigs (n = 72) were exposed in a Y-maze for 6 consecutive days to 6 randomly assigned odor treatments: control (air, CON), maple syrup (MS), NH_3, CORN, CO_2 and ChileGard™ (CHILE, habanero-based product). Twelve litter-replicates were used in this replicated latin square design (6 piglets/litter×6 treatments). Pigs were placed in a Y-maze (one arm contained nothing, the other the treatment) for one minute while video recorded. The time spent towards the treatment was divided by the total time spent in the right and left arms to express a Preference Index (PI, in %). The test day (TD)×treatment interaction was significant ($P < 0.05$). The data were analyzed per TD and compared to PI=50% (no preference). All means presented below were different ($P < 0.05$) than 50% (< 50% = aversion, > 50% = attraction). On TD 1, PI was more ($P < 0.05$) than 50 % (66.1 % ± 7.95) for CON, indicating a side preference. Pigs also preferred the odor of CORN (73.2 % ± 12.2).

All PIs were therefore compared to each TD's CON PI. On TD 2, pigs preferred NH_3(72.3 % ± 10.7) or CHILE (69.8 % ± 11.0) compared to CON. On TD 3, the PI to NH_3 was 25.8 % ±13.0 and 37.3 % ± 6.38 for CHILE, while on TD 4, the PI to CHILE was 76.3 % ± 14.1. On TD 6, pigs showed an aversion to NH_3(32.6 % ± 14.0) and a preference for MS (75.2 % ± 10.7). These results may indicate that pigs were attracted to familiar odors (CORN and NH_3) when in a novel testing environment. CHILE and NH_3 had variable effects. The PI to MS was superior to 50% only on TD 6; pigs may not have an innate preference to this novel odor. This domestic pig model must be tested in the field, but pigs were clearly attracted to a familiar feed odor (CORN) which may be useful in the field if pigs are first accustomed to the odor of corn. None of the odors tested were clearly aversive.

Key Words: Pigs, Feral Hogs, Odors

W7 Adaptation of Angus steers to long-term heat stress in the field using controlled heat challenge. B. Scharf*, L. E. Wax, D. H. Keisler, and D. E. Spiers, *University of Missouri*, *Columbia*.

Most heat stress studies are conducted using short-term, controlled exposure (i.e., 1-2 weeks) in environmental chambers or long-term summer exposure to variable field environments. This study combines both situations by utilizing the controlled conditions in the Brody Environmental Center (BEC) at the University of Missouri to effectively provide each animal with an initial baseline 'stress test.' This was followed by placement in the summer field environment (South Farm, University of Missouri) for ~3 months, to create the long-term (i.e, real world) scenario, after which animals were given another 'stress test' to determine adaptive change. Six Angus steers (365 ± 10kg BW) were housed in the BEC for 7 days at air temperature (Ta) of 20°C (TN), followed by 7 days of cyclic heat stress (HS; Ta=26°C night; 36°C day). Respiration rate (RR) and rectal temperature (Tre) were measured 6 times daily. Sweat rate was measured at shaved sites (shoulder, rump) on select days. Following the initial test, steers were placed on pasture from May to September, 2006, when Ta and THI ranges were 7.0 - 38.1°C and 49.8 - 86.9, respectively. Pre-summer (**PRE**) Tre and RR were not different from post-summer (**POS**) values at TN ($P > 0.09$). Both groups increased Tre during HS ($P < 0.0001$), with **POS** animals stabilizing faster than **PRE** animals. In comparison with Tre response to HS, RR increased more rapidly, exhibited greater **PRE** to **POS** separation, and stabilized faster to suggest that it is a more sensitive measure of HS adaptation. Sweat rate rapidly increased prior to Tre and RR during HS ($P < 0.0001$), with **PRE** level rising above **POS** ($P < 0.001$) to indicate that sweat rate is a reliable indicator of short-term heat response and adaptation. However, sweat rate decreased in **PRE** steers to **POS** level after a few days, even though Tre and RR were still elevated. This suggests that reduction of sweat rate, and possibly water loss, is more important than reduction of body temperature during heat stress.

Key Words: Cattle, Heat Stress, Adaptation

W8 Dietary supplementation with omega-3 fatty acids affects sexual behavior in boars. M. J. Estienne* and A. F. Harper, *Virginia Polytechnic Institute and State University*, *Suffolk*.

Enhancing semen quality and sexual behavior would increase efficiency in commercial boar studs. We reported (2007; J. Anim. Sci. 85[Suppl. 2]:20) that dietary supplementation with omega-3 fatty acids increased the number of spermatozoa by over 9 billion/ejaculate during a 16-wk trial. Here we report the effects of omega-3 fatty acids on sexual behavior. Yorkshire x Landrace boars, trained to mount an artificial sow, were fed 2.2 kg of a control diet (n = 12) or the control diet top-dressed with 0.3 kg of an omega-3 fatty acid supplement (JBS United, Inc., Sheridan, IN) (n = 12), daily for 16 wk. Semen was collected and libido assessed once weekly. Data were analyzed by ANOVA using a model that included treatment, period (Period 1 = wk 0 to 7 and Period 2 = wk 8 to 15), and treatment x period. The elapsed time from entering the collection pen until first interaction with the artificial sow was affected by period (15.4 sec and 8.6 sec for Periods 1 and 2, respectively; SE = 1.4; $P = 0.04$). There was a tendency ($P = 0.09$) for an effect of treatment x period for the interval between entering the collection pen and the first attempt to mount, and was 99.1 sec and 128.1 sec for controls, and 135.4 sec and 102.9 sec for boars fed omega-3 fatty acids, for Periods 1 and 2, respectively (SE = 17.4). Duration of ejaculation was affected by treatment (343.9 sec for controls and 388.8 sec for boars fed omega-3 fatty acids; SE = 7.2; $P = 0.05$). Elapsed time from entering the collection pen until the start of ejaculation (264.3 sec), and the number of false mounts (mounting the artificial sow but dismounting before a complete ejaculation was collected; 1.8) were not affected by treatment, period, or treatment x period ($P > 0.1$). Dietary supplementation with omega-3 fatty acids affected sexual behavior in boars by decreasing the time between entering the collection pen and first attempting to mount, and increasing the duration of ejaculation. (Funded by Virginia Agricultural Council)

Key Words: Boars, Sexual Behavior, Omega-3 Fatty Acids

W9 Evaluation of physiological differences in heat tolerant (Romosinuano) and heat susceptible (Angus) Bos taurus cattle during controlled heat challenge. B. Scharf*[1], L. E. Wax[1], J. A. Carroll[2], D. G. Riley[3], C. C. Chase Jr.[3], S. W. Coleman[3], D. H. Keisler[1], and D. E. Spiers[1], [1]*University of Missouri*, *Columbia*, [2]*USDA-ARS, Livestock Issues Research Unit*, *Lubbock, TX*, [3]*USDA-ARS, SupTropical Agricultural Research Station*, *Brooksville, FL*.

A study was performed to evaluate differences in thermoregulatory ability of two Bos taurus breeds with known differences in heat tolerance. Nine Angus (304 ± 7 Kg BW; **AG**) and nine Romosinuano steers (285 ± 7.5 Kg BW; **RO**) were housed in the Brody Environmental Center at the University of Missouri. Steers were housed for 14 d at thermoneutrality (21°C; TN) before initiation of heat stress. Heat stress (HS) consisted of daily cyclic air temperature (26°C night; 36°C day) for 14 d. Steers were fed a typical feedlot diet at 1.6% of BW/d. Rectal temperature and respiration rate were measured six times daily. Sweat rates were recorded on specific days throughout the study on shaved shoulder and rump sites. Analysis was repeated measure ANOVA. Respiration rate at TN was higher ($P < 0.001$) in **AG** than **RO**, by ~20 BPM. Angus steers maintained a higher rectal temperature (+0.5°C) than **RO** at TN ($P < 0.0001$). Sweat rates were also higher at TN (+6 $g/m^2/h$; $P < 0.03$). Both breeds initially increased sweat rate 4-fold during HS ($P < 0.0001$), followed by reduction after 3 d ($P < 0.0001$). Sweat rate during HS was higher ($P < 0.0001$) in **AG** compared to **RO** by ~90 $g/m^2/h$. Both breeds increased respiration rate by ~ 30 BPM during HS, with **AG** steers exhibiting the higher rate ($P < 0.0001$). Rectal temperature increased during HS for both breeds ($P < 0.0001$),

but was higher in **AG** breed ($P < 0.001$). Romosinuano steers exhibit a lower sweat and respiratory rates than **AG** during HS, while maintaining the lower rectal temperature. Indices of heat loss used in this study suggest that these avenues are not used to generate a lower rectal temperature seen in Romosinuano cattle during heat stress.

Key Words: Cattle, Heat, Tolerance

Animal Health - Livestock and Poultry: Bovine II

W10 Tumor necrosis factor-α (TNF-α), nitric oxide (NO), and xanthine oxidase (XO) responses to endotoxin (LPS) challenge in steers: Effect of progesterone (P4) and estradiol (E2) treatment. S. Kahl* and T. H. Elsasser, *USDA, Agricultural Research Service*, *Beltsville, MD*.

The severity of host response in some diseases differs between sexes and this dimorphism has been attributed to the immunomodulating effects of steroid hormones. In females, prevailing P4 or E2 concentration during different estrous cycle phases have been suggested to affect the immune responses to a disease stress. Our objective was to determine in steers the effect of P4 or E2 treatment on circulating concentrations of immune response mediators after two consecutive LPS challenges (LPS1 and LPS2, 6 d apart; 2.5 μg/kg BW, i.v., *E. coli* 055:B5). Plasma concentrations of inflammatory initiation cytokine TNF-α, nitrate+nitrite (NOx, estimate of NO production), and XO activity (mediator of superoxide production), were measured. Twenty crossbred steers (392 ± 7 kg) were fed a forage-concentrate diet (15% CP) to appetite and assigned to control (C, n = 7), P4 (n = 8) or E2 (n = 5) treatment. Progesterone (1 mg/kg BW; i.m.) and 17β-estradiol (E2, 2 mg/steer, i.m.) was injected 5, 3, and 1 d before LPS1 and LPS2. For each challenge, jugular blood samples were obtained at 0, 1, 2, 3, 4, 7, and 24 h relative to LPS injection. The primary response to LPS challenge was measured as area under the time × concentration curve (AUC). Compared to C, P4 treatment decreased plasma TNF-α AUC after LPS1 (5.68 vs 8.15 ng/mL × h, $P = 0.08$) and NOx AUC after LPS2 (32.3 vs 131.2 μM × h, $P < 0.05$). In contrast, E2 treatment augmented ($P < 0.01$) plasma TNF-α (14.66 vs 5.96 ng/mL × h) and NOx (299.8 vs 131.2 μM × h) responses to LPS2. Plasma XO AUC was increased ($P < 0.01$) over C by E2 treatment after both LPS1 (406.8 vs 179.4 mU/mL × h) and LPS2 (413.1 vs 156.5 mU/mL × h). Results indicate that in cattle, circulating P4 and E2 may, respectively, attenuate or amplify the TNF-a response to LPS challenge as well as the subsequent responses of immune mediators (NO, XO) involved in oxidative damage to animal tissues.

Key Words: Endotoxin, Estradiol, Progesterone

W11 Prevalence of *Chlamydophila spp.* in randomly selected dairy farms in the western part of Germany. K. Kemmerling*[1], U. Mueller[1], M. Mielenz[1], K. Sachse[2], J. Winkelmann[3], F. Jaeger[4], and H. Sauerwein[1], [1]*Insitute of Animal Science, Physiology & Hygiene Group, University of Bonn*, *Germany*, [2]*Federal Research Institute for Animal Health*, *Jena, Germany*, [3]*North-Rhine-Westphalian Chamber of Agricultural Matters*, *Roleber , Germany*, [4]*North-Rhine-Westphalian Ministry of Enviroment, Conservation, Agriculture and Consumers Protection (MUNLV)*, *Duesseldorf, Germany*.

Infections with intracellular bacteria of the genus *Chlamydophila* are associated with various symptoms such as infertility in cattle. Serological studies suggested a high level of exposure to *Chlamydophila spp.* but systematic epidemiological investigations for the DNA-based detection of *Chlamydophila spp.* are only scarcely available. The objective of our study was to characterize the prevalence of *Chlamydophila spp.* in dairy cows in the western part of Germany (North-Rhine-Westphalia) since the epidemiological status of dairy cattle infection with *Chlamydophila spp.* in North-Rhine-Westphalia (NRW) was unknown. In total 100 dairy farms were randomly selected. For this purpose the dairy cow stocking rate in the different administrative districts of NRW was taken into account. Ten dairy cows per farm or at least 10% of the stand density per farm were sampled. For the detection of *Chlamydophila spp.* vaginal swabs from non-pregnant, early lactating dairy cows were analysed using an established highly sensitive genus specific real-time PCR. At present, samples from 80 dairy farms i.e. from 870 individual dairy cows have been analysed. Positive testings were observed in 61% of the farms and in 15% of the cows. The lower prevalence observed on a per cow basis might be explained by the discontinued shedding of the pathogen. Nevertheless, our results suggest that *Chlamydophila spp.* is widely spread in NRW. To evaluate the impact of *Chlamydophila* infections on heard health and fertility and to developed strategies to counteract *Chlamydophila* associated health disturbances, further investigations are needed.

Key Words: *Chlamydophila*, Dairy Cows, PCR

W12 Growth, health, and select immunologic and metabolic functions of preruminant calves housed in warm and cold environments. B. J. Nonnecke*[1], R. L. Horst[1], M. R. Foote[2], B. L. Miller[3], T. E. Johnson[3], and M. Fowler[3], [1]*National Animal Disease Center*, *Ames, IA*, [2]*Iowa State University*, *Ames*, [3]*Land O'Lakes Research Farm*, *Webster City, IA*.

The physiological response of the preruminant calf to cold-stress has not been studied extensively. This study examined effects of sustained environmental cold on growth performance and health of preruminant calves. Functional measures of energy metabolism, fat-soluble vitamin and mineral status, and immune competency were also evaluated. Holstein calves, 3 to 10d of age, were assigned randomly to warm or cold environments and kept in these environments for 7wk. Cold environment calves (n=15) were exposed to temperatures maintained as close to 2°C as possible. Frequent wetting of the environment and calves was used to augment effects of the cold environment. Warm environment calves (n=14) were maintained as close to 15°C as possible. Warm environment humidity was not manipulated. Preventative medications or vaccinations that might influence disease resistance were not administered. Non-medicated MR (20% CP and 20% fat fed at .45 kg/d) and calf starter (ad libitum) were fed to all calves. During the 7wk period, cold environment temperatures averaged almost 20oC lower ($P \leq .05$) than warm environment temperatures. Relative humidity averaged 10% higher ($P \leq .05$) in cold environment. Warm environment calves were healthier and needed less medical

intervention. Growth rate was unaffected (P>.05) by environmental temperature; however, cold environment calves consumed more (P≤.05) starter at wk5, 6 and 7. Blood glucose concentrations were lower (P≤.05) and NEFA concentrations were higher (P≤.05) in cold environment calves, indicative a state of mild negative energy balance. Serum tumor necrosis factor, interferon and fat-soluble vitamin concentrations as well as antibody responses induced by vaccination were not affected (P>.05) by sustained exposure to cold. These results suggest that environmental cold has minimal effect on growth but does compromise calf health.

Key Words: Preruminant Calf, Cold Stress, Calf Health

W13 Pasteurization of colostrum reduces the incidence of paratuberculosis in neonatal calves. J. R. Stabel*, *USDA-ARS-NADC*, *Ames, IA*.

Feeding colostrum from infected dams to neonatal calves is one mode of transmission of paratuberculosis (Johne's disease). Recent studies have demonstrated improved morbidity and mortality rates in calves fed colostrum replacers or pasteurized colostrum. In the present study, the potential benefits of feeding pasteurized colostrum was demonstrated in calves born to dams naturally infected with *Mycobacterium avium* subsp. *paratuberculosis*. Calves were separated at birth from their dams and randomly allocated into a group fed the dam's colostrum, followed by feeding the dam's milk for 3 weeks (DC; n = 6), or into a group fed pooled pasteurized colostrum and milk replacer (PC; n = 5). After 3 weeks, calves were then weaned onto calf starter and housed and fed in a similar manner throughout the rest of the study. Blood and fecal samples were taken at birth and monthly throughout the 12-month study. Calves were necropsied at the end of the study and tissues were cultured for *M. paratuberculosis*. Twenty-five tissues were taken at necropsy and cultured for *M. paratuberculosis*. Sixteen of the 25 tissues were positive across treatment groups, with 14 of 16 tissues positive for DC calves and 9 of 16 tissues positive for PC calves. The degree of colonization within a tissue was low and varied between calves even within a treatment group. Fecal shedding was minimal during the study with 2 calves from each treatment group shedding negligible amounts of *M. paratuberculosis*. As a measure of early immune response to infection, blood obtained from calves was stimulated in vitro with *M. paratuberculosis* antigen preparations and IFN-gamma secretion was measured. Antigen-specific IFN-gamma was consistently higher throughout the study in calves fed colostrum and milk from their infected dams (0.95 vs 0.43 Abs540nm). These results indicate that feeding a source of clean colostrum to neonatal calves may reduce their exposure to *M. paratuberculosis*.

Key Words: *Mycobacterium avium* subsp. *paratuberculosis*, Calves, Colostrum

W14 Effects of pre- and postpartum feeding fish meal on total leukocyte and differential counts in transition and early lactating cows. A. Heravi Moussavi*[1], M. Danesh Mesgaran[1], T. Vafa[1], and A. Soleimani[2], [1]*Center of Excellence for Animal Science, Ferdowsi University of Mashhad*, *Mashhad, Khorasan Razavy, Iran*, [2]*Azad University of Kashmar*, *Kashmar, Khorasan Razavy, Iran*.

The study was designed to test the effects of dietary fish meal supplementation on total leukocyte and differential counts in transition and early lactating cows. From approximately 21 d before anticipated calving until 35 d postpartum, cows (n = 10; 5/treatment) were fed diets that were isoenergetic containing 0 (Control) or 3.5% and 1.95% fish meal during prepartum and postpartum, respectively. Holstein cows were blocked in pairs based on their previous 305 d milk, parity (2nd and 3rd to 5th) and expected calving dates. Cows within each block were randomly assigned to one of the two treatments. Blood samples were obtained by coccygeal venipuncture within one week before calving and weekly after calving using EDTA as the anticoagulant. In the blood samples total leukocyte and differential counts were determined. The data were analyzed using the MIXED model for a completely randomized design with repeated measures. The model included treatment, time and the interaction. Results showed that the total leukocytes were similar among groups (7296 and 8134 ± 599 for control and supplemented groups, respectively). The effect of time was significant (P< 0.05) and the interaction of time and treatment was not significant. Percentage of neutrophils (42.95 and 53.77 ± 4.3, respectively), lymphocytes (53.94 and 42.85 ± 4.4, respectively), and monocytes (2.88 and 2.96 ± 0.3, respectively) were all similar between control and supplemented groups. Except than monocytes percentage which was affected by time (P< 0.001), others were similar during the study. Results from this experiment demonstrate that dietary fish meal supplementation pre- and postpartum had no apparent effect on total leukocyte and differential counts in transition and early lactating dairy cows.

Key Words: Dairy Cows, Fish Meal, Leukocyte

W15 New intramammary infections during the dry period: The effect of short (30 days) vs. long (45 or 60 days) dry periods. A preliminary report. G. T. Church*[1], L. K. Fox[1], J. M. Gay[1], C. T. Gaskins[1], and C. S. Schneider[2], [1]*Washington State University*, *Pullman*, [2]*University of Idaho*, *Moscow*.

Lactating dairy cattle from 3 herds in eastern Washington and 1 herd in Idaho were enrolled in a study to test the hypothesis that cows given a **short** (theoretical 30-d dry) dry period would have no more **new intramammary infections (IMI)** than cows given a **long** (theoretical 45-d or 60-d dry) dry period. Cows were assigned systematically without bias to treatments groups. One tube of either a commercial lactating (short) or dry-cow (long) formulation of cephapirin was administered to each lactating quarter per treatment group. Duplicate quarter foremilk samples were aseptically collected prior to dry-off and single quarter foremilk samples were collected 2, 7, 14, and 21 days post partum. **Pathogens** were classified as major (coagulase positive staphylococci, streptococcal species, and coliform species) minor (coagulase negative staphylococci and corynebacterium species) or other (gram positive bacilli and arcanobacterium pyogenes). **Cured** mammary quarters were free of IMI by the pathogen isolated from milk before dry-off. **Not cured** mammary quarters had the same pathogen in milk before dry-off and after parturition. Mammary quarters with **new IMI** had a new or different pathogen in milk post partum as compared to the dry-off sample. It appears that there is approximately a 40% increase in new IMI's in long (n=23) vs. short (n=14) dry periods.

Table 1. The number of quarters that cured, did not cure, or acquired a new IMI through the dry period

	Short Dry Period			Long Dry Period		
Pathogen	Major	Minor	Other	Major	Minor	Other
Cured	1	42	2	3	31	3
Not Cured	–	15	–	–	16	–
New IMI	5	8	1	2	21	–

Key Words: New Intramammary Infection (IMI), Dry Period

W16 Muscarinic receptors in the bovine gastrointestinal tract: mRNA expression and receptor binding in healthy cows and in cows with cecal dilatation-dislocation. E. C. Ontsouka*, R. M. Bruckmaier, A. Steiner, and J. W. Blum, *University of Berne, Vetsuisse Faculty*, *Berne, Switzerland*.

Acetylcholine interacts with muscarinic receptors (M) to mediate gastrointestinal (GI) smooth muscle contractions. We have compared mRNA levels and binding sites of M1 to M5 in muscle tissues from the fundus abomasi, pylorus, ileum, cecum, proximal loop of the ascending colon (PLAC), and external loop of the spiral colon (ELSC) of healthy slaughter cows (n=7). Furthermore, we have compared mRNA levels of M2 and M3 in full-thickness biopsies from the ileum, cecum, PLAC and ELSC of healthy (n=7) and of cows with cecal dilatation-dislocation (CDD; n=7). The mRNA levels were measured by qRT-PCR. The inhibition of [3H]-QNB binding by M antagonists [atropine (M1-5), pirenzepine (M1), methoctramine (M2), 4-DAMP (M3), and tropicamide (M4)] served to identify receptor subtypes at the protein level. Maximal binding (Bmax) was determined during saturation binding with atropine as a competitor. Location and group differences of Bmax and mRNA levels were tested for significance by ANOVA. The mRNA levels of M1, M2, M3 and M5 represented 0.2, 48, 50, and 1.8%, respectively, of total M, whereas mRNA of M4 was not detected. The mRNA levels of M2 and M3 in the ileum were lower ($P < 0.05$) than in other GI–locations. Atropine and antagonists for M1, M2 and M3 inhibited [3H]-QNB binding according to a one– or a two-site receptor model . The M4 antagonist had no effect on binding. Bmax in the fundus, pylorus, and PLAC was lower ($P < 0.05$) than in the ELSC, and lower ($P < 0.05$) in the pylorus than in the ileum. In cows with CDD, mRNA of M2 (cecum, PLAC and ELSC) and M3 (all locations) were reduced by 47 to 67% and 73 to 85%, respectively, as compared to healthy cows. In conclusion, M2 and M3 appeared to be the most important M for GI motility in cows. The decreased levels observed in cows with CDD may indicate involvement of these two receptor subtypes in the motility disorder leading to CDD.

Key Words: Cattle, Motility Regulation, Receptor Expression

W17 mRNA expression of motility-mediating receptors from the abomasum to the spiral colon of healthy cows and of cows suffering from left-sided abomasal displacement. E. C. Ontsouka*, M. Niederberger, A. Steiner, R. M. Bruckmaier, and M. Meylan, *Vetsuisse Faculty, University of Berne*, *Berne, Switzerland*.

Dairy cows frequently suffer from left-sided displacement of the abomasum (LDA), which causes important economical losses. Although the symptoms of LDA are well known, the pathogenesis of the disease remains unclear. Motor functions of the gastrointestinal (GI) tract are tightly controlled by the enteric nervous system, modulated by the sympathetic and parasympathetic nervous systems, involving α- and β-adrenergic receptors (AR), as well as muscarinic receptors (M) on nerve terminals and smooth muscle cells in the wall of GI organs. In addition, a non-adrenergic and non-cholinergic pathway also influences GI motor functions via motilin receptors (MTL-R). To investigate if the expression of receptors mediating motility vary in the GI tract of dairy cows depending on their health status, we have compared mRNA levels of α2AD-AR, β2-AR, M2, M3, and MTL-R in full-thickness specimens from the abomasum (fundus abomasi, pylorus), duodenum, cecum and external loop of the spiral colon (ELSC) of freshly slaughtered healthy cows (H; n=8) and of cows with LDA (D; n=8). The mRNA levels were measured by qRT-PCR and normalized relative to GAPDH. Receptor mRNA levels were evaluated using the repeated procedure of mixed model (SAS). Differences between H and D within locations were investigated with the t-test. The mRNA levels of α2AD-AR, β2-AR, M2, M3, and MTL-R varied among GI locations ($P < 0.05$). The mRNA levels of all five receptors were lower ($P <0.05$) in the duodenum of D than of H. In addition, the mRNA levels of β2-AR were higher ($P < 0.05$) in the ELSC of D than of H. In conclusion, differences between H and D of mRNA levels for α2AD-AR, β2-AR, M2, M3 and MTL-R in the duodenum, suggests that LDA might be caused by a primary motility disturbances in this GI location rather than in the abomasum itself.

Key Words: Bovine, Gastrointestinal Motility, Receptors

W18 The relationship between postpartum uterine bacterial infection (BI) and subclinical endometritis (SE). R. O. Gilbert*, N. R. Santos, K. N. Galvão, S. B. Brittin, and H. B. Roman, *Cornell University*, *Ithca, NY*.

The reported prevalence of SE exceeds reported prevalence of uterine BI after completion of postpartum involution. The objective was to investigate the relationship between uterine BI and SE. Samples for simultaneous uterine culture and cytology were obtained from 56 Holstein cows in a single herd at 0, 7, 21, 35 and 49 (± 3) DIM. Overall positive culture was 57%, 71%, 55%, 26% and 36%, respectively. On d 0 and 7 the commonest aerobic pathogens cultured were E. coli and Streptococcus spp and from d 21 Arcanobacterium pyogenes (Apyo) predominated. Amongst anaerobes, Clostridium perfringens was cultured frequently on d 0 and 7, but seldom thereafter. Prevotella melaninogenica (Pmel), and Fusobacterium necrophorum were cultured at low rates throughout. The median proportion of neutrophils (PMN) at each time point was 37%, 20%, 41%, 7% and 4% ($P < 0.01$). The proportion of other cell types at each time point did not differ with days postpartum. The median proportion of macrophages (LMN) was zero at each time point (range; 0 to 10%), and the median proportion of lymphocytes (SMN) was 2.0% (range; 0 to 13.5%). Bacterial isolates were not correlated to proportion of LMN or SMN. On d 0 there was a significant negative correlation between PMN proportion and bacterial isolates (aerobic, $r = -0.46$, $P = 0.03$; and anaerobic, $r = -0.47$, $P = 0.07$). PMN proportion at d 0 was also negatively correlated with PMN on d 49 ($r = -0.48$, P 0.01). This suggests that prompt PMN recruitment to the uterus after parturition limits bacterial infection and reduces the risk of later SE. The PMN proportion on d 49 was correlated to

the presence of Apyo ($r = 0.49$, $P < 0.01$) and anaerobes, particularly Pmel ($r = 0.44$, $P < 0.01$). In turn, the presence of these pathogens was affected by the presence of E.coli on d 7 ($r = 0.40$, $P < 0.01$). By multiple linear regression, the presence of Apyo or Pmel explained 48% of the variance in PMN on d 49 ($P < 0.01$). The proportion of PMN on d 49, previously shown to be significantly correlated to subsequent reproductive performance was correlated to uterine BI, which was more prevalent on d 35 and 49 than previously reported.

Key Words: Endometritis, Bacteria, Dairy Cow

W19 The recurrence of mycoplasma mastitis investigated by bulk tank analysis. V. Punyapornwithaya*, L. K. Fox, D. D. Hancock, and J. M. Gay, *Washington State University*, *Pullman*.

The objective of this study was to determine the epidemiology of the recurrence of mycoplasma investigated by culture of bulk milk. Fourty farms that had *Mycoplasma spp.* culture from bulk tank milk were investigated for 1 year by further monitoring bulk tanks to determine the prevalence of recurrence of this agent. Dairies had at least 5 bulk tank milk cultures during the study. Bulk milk samples collected within the same month from 10 farms after the first positive culture were evaluated for *Mycoplasma spp*. Milk samples were plated on mycoplasma agar and incubated at 37°C with 10% CO_2 for 7 days. The percentage of farms with a recurrence of mycoplasma mastitis was 57.5% (n=23/40). The mean number of recurrences within 1 year was 2.45. Bulk milk samples from 4 herds that were examined in the same month of a first positive culture of Mycoplasma spp. were negative at the second test, as opposed to the 6 herds also tested twice in the same month that remained positive. This study suggested that the prevalence of recurrence infection of mycoplasma mastitis was greater than 50%. Cultures of bulk tank milk can be used to monitor mycoplasma mastitis, and help dairy managers use it as a tool to control the disease.

Key Words: *Mycoplasma spp.*, Mastitis, Recurrence

W20 Use of a calcium bolus to improve calcium homeostasis after calving. J. D. Sampson*[1], J. N. Spain[1], L. Carstensen[2], and C. Jones[3], [1]*University of Missouri*, *Columbia*, [2]*Boehringer Ingelheim Denmark A/S*, *Copenhagen O, Denmark*, [3]*Boehringer Ingelheim Vetmedica, Inc.*, *St. Joseph, MO*.

Milk fever occurs in 5-10% of dairy cows, and the incidence of subclinical hypocalcemia is likely several times greater. Milk fever increases the risk of numerous periparturient disorders such as ketosis and dystocia. Providing periparturient cows with supplemental calcium may decrease the risk of hypocalcemia. The objective of this study was to investigate the effects of Bovikalc™, an oral calcium supplement, on calcium homeostasis during the first 24 h after calving. Multiparous Holsteins (n=20) were blocked by parity and day of calving and randomly assigned to one of two treatment groups. Control (C) cows received no calcium supplement. Treatment group (B) received one bolus immediately after calving and a second bolus 12 hours after calving. All cows were housed in a sand bedded free stall barn with free access to clipped pasture and fed a TMR formulated to meet NRC requirements. Prepartum blood samples were taken at approximately 24 and 48 hours prior to calving. Ionized blood calcium (iCa) was measured using an IDEXX Vet Stat Analyzer. Cows with an iCa level of 1.10 mmol/L or less were included in the study. Blood and urine samples were collected at 0, 1, 6, 12, 13, and 24 hours postpartum. Blood was analyzed for iCa and pH. Urinary pH was measured. Rectal temperatures and clinical scores for appetite, ataxia, fecal consistency, and muscle tremors were recorded at 0, 6, 12, and 24 hours postpartum. iCa levels were not different between treatment groups (1.24 vs. 1.22 and 1.19 and 1.18 mmol/L for C and B at -48 and -24 h, respectively. iCa levels were similar at calving (0h, 0.95 vs. 0.94 for C and B, respectively, P=0.84. iCa levels differed due to treatment over time (P=0.02). iCa were significantly higher in cows given the bolus at 1 and 13 hour. Urine pH was different by treatment (P=0.002) and by treatment over time (P=0.003). Urine pH decreased in cows given B from 7.58(0h) to 6.79 (24h) compared to 8.00 (0h) to 8.09 (24h) for control cows. Blood pH was not different (P=0.27). Calcium supplementation with Bovikalc™ after calving decreased urine pH and increased iCa levels compared to control cows.

Key Words: Milk Fever, Calcium, Dairy

W21 Dietary fish oil does not impact the response of early lactating cows to an endotoxic mastitis challenge. M. K. Yelle*, D. W. Kim, E. J. DePeters, and M. A. Ballou, *University of California*, *Davis*.

Cows in early lactation are more susceptible to the deleterious local and systemic effects of the acute phase response. Supplementing fish oil in many animal models attenuated the acute phase response. The objective was to determine the effects of supplementing fish oil during the peripartum period on the pathophysiological response to an intramammary LPS challenge. 42 multiparous, Holstein cows were completely randomized to one of three treatments at 3 weeks prepartum. Treatments were no supplemental lipid or supplemental lipid, 250 g (prepartum) or 1% of the previous day's intake (postpartum), from either Energy Booster® (EB) or fish oil (FO). Supplemental lipid was fed as a bolus prior to the AM feeding. At 7 DIM cows supplemented with lipid were infused with 100 µg of E coli LPS into one rear quarter; cows not supplemented with lipid served as un-infused controls. DMI was measured daily and clinical measures taken at 0, 1, 2, 3, 4, 5, 6, 8, 12, 24, and 72 h. Blood samples were collected at 0, 2, 4, 6, 8, 12, 24, and 72 h for biochemical analyses. Milk samples were collected before and from the 6 milkings following the LPS challenge. All data will be reported as EB versus FO respectively. For EB and FO, LPS caused a significant increase in both rectal temperature and heart rate, which peaked at 6 h. Total white blood cell counts decreased following LPS, reaching nadir after 6 h. Supplemental lipid source had no effect on any clinical response. Feed intake significantly decreased the day LPS was infused (16.6 and 17.0%). LPS increased serum glucose levels and caused a significant biphasic decrease in NEFA, reaching nadir at 4 and 8 h and returning to baseline levels within 24 h. Milk production in the infused quarter decreased dramatically over the first two milkings (33.9 and 41.8%) and returned to baseline by the 5th milking. Control quarters also decreased and reached nadir at the 1st milking (15.4 and 12.9%) but quickly recovered to baseline production by the 2nd milking. Supplementing fish oil had no ameliorative effect on either the local or systemic acute phase response of early lactating, Holstein cows.

Key Words: Endotoxin, Mastitis, Transition

W22 *Escherichia coli* lipopolysaccharide upregulates the expression of both toll like receptor 4 and 2 (TLR4 and TLR2) in cultured bovine mammary epithelial cells. E. M. Ibeagha-Awemu*[1], J.-W. Lee[2], A. E. Ibeagha[1], D. D. Bannerman[3], M. J. Paape[3], and X. Zhao[1], [1]*McGill University*, *Ste Anne De Bellevue, Quebec, Canada*, [2]*National Pingtung University of Science and Technology*, *Neipu, Pingtung, Taiwan*, [3]*United States Department of Agriculture*, *Beltsville, MD*.

Bovine mammary epithelial cells contribute to the innate immune response to intramammary infection. Their ability to mount such a response is dependent upon mammary epithelial recognition of the invading pathogen by specialized receptors. Toll-like receptor 4 (TLR4) is one such receptor that recognizes and is specifically activated by lipopolysaccharide (LPS), a component of the outer envelope of gram-negative bacteria. Recently, it was shown that Staphylococcus aureus, a gram-positive bacteria, initiated the upregulation of both TLR2 and TLR4 in the bovine mammary gland. Because the mammary gland is known to elicit a robust innate immune response to *Escherichia coli*, we hypothesized that LPS could similarly induce upregulation of TLR4. To evaluate this, MAC-T cells (a bovine mammary epithelial cell line) were incubated in the presence or absence of 1 μg/ml LPS for 24 hrs. Expression of TLR2 and TLR4 were analyzed at both the mRNA and protein levels by quantitative real time PCR and flow cytometry, respectively. The mRNA for both receptors in treated cells was upregulated by 2.0 (TLR4) or 2.2 (TLR2) fold ($P<0.01$) in comparison to untreated cells. Similarly, specific antibodies against TLR2 and TLR4 detected the increased surface expression of the toll proteins. The mean channel fluorescence in treated cells as compared to untreated cells was 1224 vs. 554 for TLR4 and 3394 vs. 1671 for TLR2, respectively. These results demonstrate that LPS upregulates both TLR4 and TLR2, similar to that reported with ligands from S. aureus. This suggests that the bovine mammary epithelium possesses the necessary immune repertoires required to mount a robust defense against *E. coli*. This may also indicate a positive adaptation by the mammary epithelial cells to effectively deal with different types of mastitis pathogens.

Key Words: Lipopolysaccharide, TLR4 and TLR2, Mastitis

W23 Effect of supplementation with a *Bacillus*-based direct-fed microbial on calf growth, *Clostridium perfringens* shedding, and incidence of scours. C. Wehnes*[1], E. Davis[1], K. Novak[1], V. Patskevich[1], T. Rehberger[1], D. Shields[2], and J. Coalson[2], [1]*Agtech Products, Inc.*, *Waukesha, WI*, [2]*Merrick's, Inc.*, *Union Center, WI*.

Electrolytes are common and effective treatments for dehydration in calves; however, electrolytes do not treat the primary cause of dehydration, bacterial and viral associated scours. The objective of this study was to evaluate the efficacy of the addition of a *Bacillus* direct-fed microbial (DFM) to an electrolyte as therapy for scours. The DFM was evaluated based on calf performance and fecal *C. perfringens* shedding. In October 2006, 65 Holstein bull calves were placed in outdoor hutches and 21 calves were randomly selected to determine preliminary *C. perfringens* fecal shedding. Calves were assigned to three treatments based on the presence of scours: non-scouring, electrolyte, and electrolyte+DFM. Scouring calves received electrolyte for a mandatory two days. Fecal samples were collected on d 1, 3, 7, 14, 21, 28, and 42 post-placement and enumerated for *C. perfringens*. *C. perfringens* colonies were harvested and DNA was extracted. Putative *C. perfringens* colonies were confirmed as *C. perfringens* via multiplex Polymerase Chain Reaction (mPCR) for the four major *C. perfringens* toxin genes (α, β, ε, and ι). randomly amplified polymorphic dna pcr (rapd pcr) was performed to characterize *C. perfringens* isolates. By d 14, 49 of the 51 scouring calves were treated. Although results indicate that electrolyte+DFM calves began the trial with significantly greater ($P = 0.01$) populations of fecal *C. perfringens*, by d 7 the electrolyte+DFM significantly reduced ($P = 0.002$) populations of fecal *C. perfringens* compared to electrolyte alone. Electrolyte+DFM calves had significantly higher ($P = 0.02$) ADG than both non-scouring and electrolyte treated calves in wk 1. Gain:feed was significantly greater ($P = 0.04$) in electrolyte+DFM calves than calves administered electrolyte and non-scouring treatments during wk 8. Results indicate that supplementation of electrolyte+DFM reduced *C. perfringens* fecal shedding and improved gain during wk 1. The DFM may have other ancillary benefits after feeding has ended, as evidenced by improved gain:feed in wk 8.

Key Words: Probiotic, Bovine, Electrolyte

W24 Prevalence, etiology and antimicrobial sensibility of subclinical mastitis. M. C. Rubio Robles*, M. A. Luque, R. Verdugo, R. Chin, R. Félix, E. Hernández,, T. Leal, and J. Mena, *Universidad Autonoma de Sinaloa*, *Culiacan, Sinaloa, Mexico*.

Mastitis is an inflammation of the mammary gland, the subclinical mastitis is characterized not to cause a visually inflammation of the mammary gland, nor macrocospic changes in milk, being necessary for their diagnosis tests that allow to detect the involved microorganisms. both clinical and subclinical forms of mastitis cause a reduction in milk quality and quantity and is recognized as a cause of major economic loss to the dairy industry. The objective of this study was to determine the prevalence of subclinical mastitis and its causal agents in familiar dairy stables, in San Jose of the Brecha, located in 137 km Culiacán-Guasave highway; municipality of Guasave, Sinaloa, Mèxico. where sampled 24(100%) cows of American Swiss Brown with Brahman, 3 to 8 childbirths and weights of 350 to 400 kg, fed at prairie, including all the cows of milks, except less than 15 days of lactation and more than 7 months of gestation; using the California mastitis test, resulted 100% of the dairy stables presence of subclinical mastitis; 62.5%(15) of the cows was positive, and 37.5%(9) negative. In the positive cows 26(27.08%) of the quarters were infected with some degree of mastitis, 57.69%(15) degree 1, 34.61%(9) degree 2 and 7.69%(2) degree 3. The positive samples were analysed with bacteriological and antibiograms in the Bacteriology laboratory of the FMVZ-UAS. showed 18.18%(2) development of Staphylococus spp, rest 81.1%(9) was negative. In antimicrobial sensitivity Staphylococus spp was resistant to the Enoxacin and the Dicloxacillin, very susceptible and moderately susceptible to penicillin and the anetilmicin. it is concluded that the prevalence of subclinical mastitis in San Jose of the Brecha is present in all the familiar dairy stables and a considerable proportion in cows, which can trigger another type of mastitis (clinical) producing lost economic considerable the producers.

Key Words: Mastitis, Dairy Cattle, Prevalence

W25 A cross-sectional survey of *Salmonella* serotypes from dairies with a history of Salmonellosis in the Great Lakes Region of the United States. C. Wehnes*, V. Patskevich, K. Mertz, and T. Rehberger, *Agtech Products, Inc.*, *Waukesha, WI*.

Characterization of *Salmonella* shedding to identify cattle and herd associated risk factors has been well researched; however, there is a paucity of data characterizing *Salmonella* strains across dairies. For these reasons, a cross-sectional survey of *Salmonella* on dairies with a history of Salmonellosis was performed with the objectives of assessing *Salmonella* prevalence, serotype, and strain diversity. From June to December 2006, fecal samples from cows and calves as well as bedding samples from cow, calf, and sick cow pens were collected from eight independent dairy farms experiencing Salmonellosis. Each sample was cultured for *Salmonella*; putative colonies were confirmed as *Salmonella* via a latex agglutination assay (Remel, Lenexa, KS). DNA was extracted from *Salmonella* positive colonies and Randomly Amplified Polymorphic DNA Polymerase Chain Reaction (RAPD PCR) was performed. RAPD PCR products were analyzed using BioNumerics software (Applied Maths Inc. Austin, TX) to assess *Salmonella* diversity. Of the 196 fecal and 104 bedding samples collected, 42 (21%) and 37 (36%) contained *Salmonella* respectively. Serogroups found included B (13%), C (52%), D (3%), and E/G (32%). A total of 342 isolated *Salmonella* colonies were collected throughout the study. The results of the *Salmonella* genotypic diversity survey indicate that the strain richness (S) and evenness (E_D) for the 342 *Salmonella* isolates was 56 and 0.35 respectively at 80% similarity using the Pearson similarity coefficient with the unweighted pair group method using arithmetic averages (UPGMA). The reciprocal of the Simpson Index (1/D) was 19 and D_{max} was 56. The RAPD PCR results indicate that these farms contained *Salmonella* strains with little genotypic diversity within each farm. Conversely, the genotypic diversity between farms is large with few overlapping strains present. Future research should focus on further characterizing *Salmonella* from dairies as a means to understand the basis of farm specific isolates.

Key Words: Dairy, Diversity, Prevalence

W26 Correlating body weight and temperature changes after antibiotic treatment of morbid stocker calves with health and growth performance throughout the receiving phase. S. Behrends*, E. B. Kegley, and J. A. Hornsby, *University of Arkansas*, *Fayetteville*.

Records from market stressed bull and steer calves (n = 383) initially weighing 237 ± 46 kg were studied to identify an easily obtainable measurement that could be taken after an antibiotic treatment (AT) and used as a prognostic tool for calves affected by bovine respiratory disease (BRD). Calves were evaluated for signs of BRD and assigned a critical illness score of 1 (normal) to 5 (moribund). Based on these evaluations calves ≥ 2 were pulled. Calves that exhibited a rectal temperature of ≥ 40°C were weighed and administered an AT. Rectal temperatures and body weights (BW) were taken 2 to 3 d after each treatment (according to product label). Calves that continued to exhibit a rectal temperature of ≥ 40°C were administered another AT. Calves were treated with up to 3 antibiotics and were considered chronic if they did not respond (temperature < 40°C) to the third treatment. A negative correlation existed between calves administered one AT and BW on d 7 and 42 (r = -0.15; P < 0.01 and r = -0.24; P < 0.0001 respectively). Body weights on d 15 and 42 were negatively correlated with whether calves were administered a second (r = -0.14; P = 0.02 and -0.23; P < 0.0001, respectively) and third (r = -0.13; P = 0.03 and r = -0.23; P = 0.0001, respectively) AT. Body weight change during the AT period (between initial pull and recheck) was negatively correlated with the need for a second and third AT (r = -0.14; P = 0.03 and r = -0.29; P = 0.005, respectively). Rectal temperature change (between initial pull and recheck) during the first AT period was correlated with those calves that were treated a second and third time (r = 0.36; P < 0.0001 and r = -0.33; P < 0.0001). Weight and temperature change during AT appear to both be useful indicators of potential outcomes for calves that are affected by BRD.

Key Words: Stocker Calves, Bovine Respiratory Disease, Antibiotic Treatment

W27 Feeding unprotected fish oil 3 weeks prepartum alters the fatty acid composition of plasma in both the cow and calf at parturition, but had no effect on bactericidal or cytokine function. M. A. Ballou*, R. C. Gomes, and E. J. DePeters, *University of California*, *Davis*.

Previous research from our lab demonstrated that supplementing a milk replacer with fish oil attenuated the acute phase response in calves; however it took weeks to months of fish oil (FO) supplementation before docosahexaenoic acid (DHA) and eicosapentaenoic acid (EPA) reached a new steady state, respectively. The objectives were to determine whether feeding a rumen unprotected FO would alter the fatty acid (FA) composition of plasma from both the cow and calf at parturition; as well as evaluate bactericidal and cytokine function. 30 Holstein cows were completely randomized to one of two treatments at 3 wk prepartum. Treatments were either 250 g of (1) Energy Booster® (EB) or (2) FO fed as a bolus prior to the AM feeding. Plasma was sampled from each cow at enrollment and from the cow and calf on the day of parturition for FA analyses of plasma phospholipids. At enrollment and parturition peripheral blood mononuclear cells (PBMC) were isolated from the cow and cultured with phytohemagglutin; IFN–γ and TNFα were quantified. Whole blood bactericidal capacity against 3 microorganisms was evaluated at enrollment, parturition, and +21 d. In the calf, the whole blood bactericidal assay was measured 2 h after parturition, +1, and +21 d. In the cow FO increased the concentrations of EPA (3.38 vs. 0.62 g/100g FA), and DHA (2.74 vs. 0.29 g/100gFA) when compared to EB. Furthermore, FO increased EPA (0.81 vs. 0.39 g/100g FA) and DHA (2.09 vs. 1.12 g/100g FA) concentrations in the calf at calving. FO had no effect on the arachidonic acid concentration in the cow and calf. FO had no effect on the production of IFN–γ and TNFα from PBMC cell cultures. Furthermore FO had no effect on the bactericidal capacity of blood from either the cow or calf against any of the microorganisms. Supplementing the close-up diet with FO dramatically altered the FA composition of plasma from the cow and her calf at parturition. However, the plasma concentrations of EPA and DHA in the calf were below what can be acquired by supplementing the calf during the neonatal period.

Key Words: Immune, Fish Oil, Fatty Acid

W28 Relationship of plasma immunoglobin G concentrations to temperament and growth performance. K. R. Parker*[1], S. T. Willard[2], R. D. Randel[3], T. H. Welsh, Jr.[4], and R. C. Vann[1], [1]*MAFES-Brown Loam Experiment Station*, *Raymond, MS*, [2]*Mississippi State University*, *Starkville*, [3]*Texas A&M University Agricultural Research & Extension Center*, *Overton*, [4]*Texas A&M University*, *College Station*.

This study was designed to assess the relationships between immune function, innate temperament and growth performance. Blood samples and BW were taken from spring born calves (n = 196) at 24h, 48h, 14d, and 84d post-calving. At birth calves were assigned a calf vigor score, calving ease score and dams were given a BCS according to Beef Improvement Federation guidelines (2002). Plasma was harvested via centrifugation and concentrations of immunoglobin G (IgG) were determined by ELISA. Temperament data were recorded in the form of pen scores (PS) and exit velocity (EV). These measures were taken along with BW at 28d pre-weaning, weaning, 28d post-weaning, 56d post-weaning and as yearlings. Overall temperament scores (TPS) were assigned to each animal by averaging PS and EV over the four time periods. Statistical analyses were performed using the Proc Mixed procedure of SAS and where appropriate repeated measures analyses were used. Calves were ranked based on their TPS as follows: calves 1 SD above the mean were considered temperamental (T, n=26), calves 1 SD below the mean were considered calm (C, n=36), all other calves were considered intermediate (I, n=127). Calves were classified based on their IgG concentration with calves 1 SD lower than the mean ranked low (L, n=3), calves 1 SD above the mean ranked high (H, n=27), and remaining calves ranked moderate (M, n=159). Heavier calves at birth ($P \leq 0.05$) had lower IgG at 24h and 48h. Calves with higher IgG at 48h exhibit greater ($P = 0.062$) ADG between weaning and 56d. Calves with higher IgG concentrations did not experience calving difficulties ($P \leq 0.001$). Scrotal circumference (SC) at weaning and 56d post-weaning were higher ($P \leq 0.03$) for calves with greater 48h IgG concentrations and were higher in calves classified as calm. Calves with higher immune classification had improved growth performance after weaning. These results suggest that IgG classification could be useful in predicting growth performance after weaning.

Key Words: Immunoglobin, Beef Calves, Temperament

W29 Impact of entomopathogenic fungus *Metarhizium anisopliae* on cattle naturally infested by adult *Haematobia irritans* in temperate Mexico. E. Maldonado-Simán[1], R. D. Améndola-Massiotti*[1], E. Galindo-Velasco[2], C. A. Angel-Sahagún[2], L. Bermúdez-Villanueva,[1], and R. Lezama-Gutiérrez[2], [1]*Universidad Autónoma Chapingo*, *Chapingo, México, México*, [2]*Universidad de Colima*, *Tecomán, Colima, México*.

Farmers tend to control horn fly (*Haematobia irritans* L.) with heavy pesticide applications which increase the risks of insecticide residues in products and the environment; therefore, biological pest control is considered to be ecologically safer. The University of Colima, Mexico recently developed a biopesticide based on the spores of the fungus *Metarhizium anisopliae* Ma34 as a natural pathogen. No studies have tested on the field the action of this entomopathogenic fungi on the control of *H. irritans*; therefore, the aim of this study was to asses the efficacy of *M. anisopliae* on the control of *H. irritans* in naturally infested cattle. The study took place in the Experimental Station of the University of Chapingo (temperate central area of the country). Twenty two grazing Holstein cows were randomly allocated into two groups of the same size, which grazed in different paddocks. Cows in the treated group were sprayed every seven days with a conidial suspension of *M. anisopliae* (strain Ma34) at a concentration of 1×10^8 conidia/ml. Eight applications took place during the experimental period. The other group remained as untreated control. The horn fly burdens were recorded on days 0, 1, 2, 3, 4, 5, 6 and 7 post-treatment. Cows sprayed with *M. anisopliae* showed fly counts 28% lower than the untreated control ($P<0.05$). Since the experiment took place during the second half of the fall, horn fly counts became lower through time (from week one to week eight) in both treatments, being reduced from 156 to 24 flies per cow in the sprayed cows and from 216 to 37 flies per cow in the untreated cows; the reduction due to the application remained fairly constant. This result shows that *M. anisopliae* (strain Ma34) was effective in the control of adult *H. irritans* and might be a promising substitute of chemical pesticides.

Key Words: Hyphomycetes, Biological Control, Horn Fly

Breeding and Genetics - Livestock and Poultry III

W30 The genes commonly expressed at early embryonic stages in mammals. C. Y. Lien*, E.-C. Lin, C. C. Hsu, S. T. Ding, and W. T. K. Cheng, *National Taiwan University*, *Taipei, Taiwan*.

The early stages of embryogenesis are critical for mammalian embryo development. Several key developmental events occurred in these stages, such as cell growth, migration, differentiation, and morphogenesis. In spite of the importance occurring in the early embryogenesis, limited information has been provided by previous studies. The UniGene database in the National Center for Biotechnology Information (NCBI) was designed to collect sequences of expressed sequences tags (ESTs) and mRNA to provide many sets of transcript sequences from the same transcription locus.The purpose of this study is to utilize the UniGene database to screen those commonly expressed genes with related functions at early embryonic stages in mammals. Those unigene entries of embryos before implantation collected from *Bos taurus*(Bt), *Mus musculus* (Mm) and *Sus scrofa* (Ssc) were 1,727, 13,923 and 3,982, respectively. The unigene sequences of Mm (13,923) were used to search against (blastn) the unigene sequence sets of Bt (1,727) and Ssc (3,982) to obtain 972 and 2,039 commonly expressed genes (bit score ≥ 200), respectively. However, there were 417 unigene entries commonly expressed in all these three species. The 417 commonly expressed genes annotated to have certain gene identity in public databases for Bt, Mm and Ssc were 339, 361 and 151, respectively. Furthermore, those commonly expressed unigenes of Mm were annotated their functional classification using Gene Ontology terms into three categories: biological process (P), molecular function (F) and cellular component (C). The results showed the number of commonly expressed genes with functional annotation were 160 (P), 169 (F) and 153 (C), respectively. The commonly expressed genes and their related functions might be annotated using alignment tool among sequence databases of different species. The analytical procedure in this study would assist animal scientists to screen the commonly expressed genes with fundamental roles and functions.

Key Words: Early Embryonic Stages, Commonly Expressed Genes, Mammals

W31 Environmental and genetic effects on growth traits of farmed red deer. R. Ramírez-Valverde*, A. Sánchez-Cervantes, J. G. García-Muñiz, and R. Núñez-Domínguez, *Universidad Autónoma Chapingo*, *Chapingo, México, México*.

Currently, there are in Mexico only a handful of farms with farmed red deer; however, in recent times their number has increased, therefore, it is important to characterize this species under main production systems. The objective of this study was to identify environmental and genetic effects on growth traits, in a herd of farmed red deer in Mexico. The animals were raised on an intensive rotational grazing system of grass-legume mixed temperate pastures. Evaluated traits (n=270 to 428) were weights at birth (BW), weaning adjusted to 100 d (WW) and yearling (YW), for males and females born from 1996 to 2003. Analyses were performed using the MTDFREML program. Final univariate animal models considered the fixed effect of sex-year (contemporary group), age of dam at calving as a covariate for BW and WW, and the direct (BW, WW and YW) and maternal (WW) random genetic effects. Contrasts were performed to determine statistical differences within fixed and covariates effects. Genetic evaluation was carried out in the total of the pedigree (n=528). Means and standard deviations for BW, WW and YW, were 8.7±1.2, 42.4±5.6 and 80.8±13.3 kg, respectively. Means for BW, WW and YW of males were higher (P<0.05) than those of females (4.6, 9.9 and 21.9%, respectively). There were differences between contemporary groups (P<0.05). Linear and quadratic age of the dam affected (P<0.05) both BW and WW. For BW, the heaviest weights were predicted for dams with an age of 36.9 months, while for WW a maximum was achieved at 108.7 months of age. Estimators of direct heritability were 0.00, 0.41 and 0.17, for BW, WW and YW, respectively. Maternal heritability for WW was 0.22. Standard deviations of direct breeding values were 1.4 and 1.3 for WW and YW, and 1.0 for maternal WW. As expected (no selection for growth traits), genetic trends for WW and YW were not different from zero (P>0.05). Based on the genetic variability of WW and YW, the results suggest the possibility of genetic improvement of those traits through selection in this herd.

Key Words: Heritability, Grazing, Animal model

W32 Effects of selected weather factors on feed intake of Angus, Polled Hereford, and Simmental beef bulls during feedlot performance tests. G. T. Tabler, A. H. Brown, Jr.*, E. E. Gbur, I. L. Berry, Z. B. Johnson, D. W. Kellogg, and K. C. Thompson, *University of Arkansas*, *Fayetteville*.

Selected weather data were analyzed to more closely define the relationship between climate and feed intake of three breeds of beef bulls during feedlot performance tests. Intake data originated from Angus (n = 282), Polled Hereford (n = 440) and Simmental (n = 372) bulls in University of Arkansas Cooperative Bull Tests from 1978 to 1990. Bulls were given a 21-d adjustment period, then individually full-fed a total mixed ration twice daily in the same stall for 140 d. Initial age and weight were recorded at start of each test with weights taken at 28-d intervals. Data were pooled, divided into five 28-d periods beginning with start of each test, with data from each period and breed analyzed separately. Initial age and weight were included in principal components regression as independent variables to adjust for initial animal differences. Principal component (PC) analysis was utilized to reduce number of independent variables in the regression and overcome collinearity concerns associated with numerous climatic variables. Initial weight and initial age had positive regression coefficients throughout the trial for each breed. Regression coefficients for effects of weather variables ranged from positive to negative depending on period and breed. No weather variable had a consistent effect throughout all five periods across all three breeds; although, effect of barometric pressure was positive in all periods for Polled Hereford and Simmental bulls. Results indicated rainfall, relative humidity, barometric pressure, day length, and wind speed have individual effects on feed intake. Additional evidence is provided indicating that temperature alone is inadequate to represent effects of weather on feed intake of various beef cattle breeds used in production systems today.

Key Words: Beef Cattle, Breed, Climate

W33 Promoter region of the bovine growth hormone receptor (GHR) gene: Resequencing, SNP detection, and association with performance traits in Brangus bulls. A. J. Garrett*[1], G. Rincon[2], J. F. Medrano[2], G. A. Silver[1], and M. G. Thomas[1], [1]*New Mexico State University*, *Las Cruces, New Mexico, United States*, [2]*University of California*, *Davis*.

Expression of the growth hormone receptor (GHR) gene and its binding with growth hormone is essential for growth. A TG microsatellite exists in the 5′ untranslated region (UTR) of bovine GHR segregating a short (11 bp) and a long (14-16 bp) allele. Favorable associations with carcass characteristics have been found with the longer allele in Angus cattle. Herein, a 1000 bp region flanking the TG microsatellite was resequenced to detect SNPs and completed an association study of genotype/haplotype to phenotype in performance tested Brangus (3/8 Brahman x 5/8 Angus; n = 340 from 80 sires) bulls. Target region was resequenced in twenty four familialy unrelated beef animals including Simmental, Angus, Brahman, and Brangus. Nine sequence variations were identified and 5 were genotyped via Taqman® assays. Haplotype analysis indicated polymorphisms were in phase ($r^2 = 0.84$; $D' = 0.92$) and an A/G tag SNP (125634) was identified. Mendelian segregation was verified using three generation families. The A allele was derived from Brahman and the G allele was derived from Angus. The AA genotype of the SNP was found to be a predictor of yearling weight with AA genotype being heavier ($P < 0.05$) than the AG or GG genotypes. Least squared means for intramuscular fat percentage (IMF) for genotypes of the SNP were 3.55, 3.60, 3.73 ± 0.08 for AA, AG, and GG genotypes respectively, suggesting an inverse relationship between yearling weight and IMF. Regression on the number of favorable alleles summed across markers appeared additive with a slope coefficient of 0.10 ($P < 0.03$). Prediction analysis involving haplotypes suggested animals possessing Angus alleles had greater (0.69 > 0.64 ± 0.03 cm, $P < 0.05$) rib fat than those possessing Brahman alleles. A GHR SNP in the 5′ UTR was associated with growth and carcass traits. The favorable allele segregated from Angus and appears additive for IMF in Brangus bulls. The A/G tag SNP may offer an alternative method of genotyping to the TG microsatellite in association studies involving body fat traits and yearling weight in Brangus cattle.

Key Words: Cattle, SNP, Growth Hormone Receptor

W34 Animal model analyses of additive and non-additive genetic effects for 205-day weight in a Nellore x Hereford multibreed population in Brazil. A. de los Reyes[1], M. A. Elzo*[2], V. M. Roso[3], R. Carvalheiro[3], L. A. Fries[3], and J. L. Ferreira[1], [1]*Federal University of Goias*, *Goiania, GO, Brazil*, [2]*University of Florida*, *Gainesville*, [3]*GenSys Associated Consultants*, *Porto Alegre, RS, Brazil*.

Choosing an appropriate model to obtain reliable estimates of additive and nonadditive genetic effects is essential for the implementation of a sound crossbreeding program. The objective of this study was to assess the importance of direct and maternal breed additive, dominance, and epistatic recombination group effects for 205-d weaning weight (W205) in a large Nellore x Hereford multibreed population using 11 homoscedastic animal models. Four epistatic recombination expressions were evaluated: 1 (Dickerson) = NsHs + NdHd; 2 (Fries) = 0.5(HETs + HETd); 3 (Kinghorn) = 2NaHa; and 4 (Elzo) = 1 - NsNsNdNd - HsHsHdHd; N = Nellore fraction, H = Hereford fraction, HET = heterozygosity, a = animal, s = sire, and d = dam. The data file had 124,638 W205, 3,768 contemporary groups (CG = herd-year-season-management group-sex of calf), 1,078 sires, and 88,750 dams. The pedigree file included 202,475 animals. Fixed effects were CG, cow age at calving (fourth degree polynomial), weaning age as a deviation from 205 d (third degree polynomial), direct and maternal breed additive effects (models 2 to 11), direct and maternal heterosis (models 3 to 11), and direct and maternal epistatic recombination effects (direct: models 4 to 11; maternal: models 5, 7, 9, 11). Random effects were direct and maternal additive genetic effects, maternal permanent environmental effects, and residual effects. Additive relationships were accounted for. The Akaike (AIC) and Bayesian (BIC) information criteria were used to compare models. Inclusion of direct and maternal heterosis, and direct and maternal epistatic recombination (all definitions) showed an improvement in model fitting according to AIC and BIC (except for maternal epistatic recombination in models 9 and 11). Thus, both heterosis and epistasis need to be accounted for in genetic evaluation models for this multibreed population.

Key Words: Cattle, Multibreed, Recombination

W35 Growth and pubertal development of F_1 bulls from Hereford, Angus, Norwegian Red, Swedish Red and White, Friesian, and Wagyu sires. E. Casas*, D. D. Lunstra, L. V. Cundiff, and J. J. Ford, *USDA, ARS, U.S. Meat Animal Research Center*, *Clay Center, NE*.

The objective of the study was to characterize growth, testicular development and puberty between 9 and 14 mo of age in bulls (n = 120) produced by mating sires from Hereford (H), Angus (A), Norwegian Red (N), Swedish Red and White (S), Friesian (F), and Wagyu (W), to MARC III (¼ Hereford, ¼ Angus, ¼ Red Poll, ¼ Pinzgauer) cows. Traits evaluated were birth weight, weight at 200 d, weaning weight (at 215 d), yearling weight, average daily gain from 8 to 14 mo of age, paired testis volume growth from 8 to 14 mo of age, age at puberty (determined by production of 50 x 10^6 sperm with 10% motility), age at freezable semen (determined by production of 500 x 10^6 sperm with 50% motility), paired testis weight, and daily sperm production per testis pair at 15 mo. At birth; animals with H and F inheritance were heavier (43 kg and 41 kg, respectively, $P = 0.04$), when compared to those with N, S, and W inheritance (39 kg, 38 kg, and 38 kg, respectively). Differences in weight were also observed at one year of age ($P = 0.004$), where the heaviest animals were those with A inheritance (450 kg), while the lightest animals were those with W inheritance (403 kg). Bulls with W inheritance had the lowest ($P = 0.0003$) average daily gain (1.13 kg/d) when compared to bulls with inheritance from H (1.23 kg/d), A (1.29 kg/d), N (1.27 kg/d), S (1.24 kg/d), and F (1.27 kg/d). No differences ($P = 0.14$) were observed for paired testis volume growth rate. They ranged from 1.95 in A sired to 1.66 cm^3/d in W sired bulls. There was a tendency ($P = 0.06$) of sire breed for age at puberty. The range was from 268 to 302 d. There were no differences ($P > 0.05$) for paired testis weight and daily sperm production. Growth of animals with W inheritance is slower than animals with N, S, F, H, or A inheritance. At 15 mo of age testicular development was similar for all breeds despite predicted differences in mature body weight.

Key Words: Beef Cattle, Bulls, Puberty

W36 Evaluation of post-weaning phenotypic residual feed intake in an Angus-Brahman multibreed herd of beef cattle. M. A. Elzo*[1], G. R. Hansen[2], J. G. Wasdin[1], J. D. Driver[1], and J. L. Jones[1], [1]*University of Florida*, *Gainesville*, [2]*North Florida Research and Education Center*, *Marianna, FL*.

Residual feed intake (RFI) has become ubiquitous for evaluating feed efficiency in cattle. The objective here was to evaluate phenotypic RFI in a group of 200 bull, heifer, and steer calves of breed compositions ranging from 100% Angus (A) to 100% Brahman (B). Calves were born in Gainesville, Florida, from December 2005 to March 2006, and moved to a GrowSafe automated feeding facility in Marianna, Florida, in September 2006. Calves were randomly allocated to 10 pens of 20 calves each by sire group (1 = A, 2 = ¾ A ¼ B, 3 = Brangus, 4 = ½ A ½ B, 5 = ¼ A ¾ B, and 6 = B) and sex (bull, heifer, and steer). Calves were fed a concentrate diet composed of whole corn, soybean hulls, corn gluten feed, cottonseed hulls, and a protein, vitamin, and mineral supplement (DM = 91.2%, CP = 17.3%, DIP = 11.3%, NEm = 1.7 mcal/kg, and NEg = 1.2 mcal/kg). There was a pre-trial adjustment period of 21 d. Individual daily feed intake and weekly weights were obtained during a 70-d feeding trial. Phenotypic RFI was computed as the difference between the actual feed intake and the expected feed intake (function of average daily gain and metabolic mid-weight). Phenotypic RFI was analyzed using a homoscedastic mixed linear model. Fixed effects were pen, age of dam, sex of calf, initial age, initial weight, Brahman fraction of calf, and probability of A and B alleles at 1 locus in the calf. Random effects were sire and residual. Important effects were sex ($P < 0.002$; Males had lower RFI than females), initial weight ($P < 0.02$), and Brahman fraction ($P < 0.02$; Brahman had lower RFI than Angus). Subsequently, calves were assigned to 3 RFI groups: high (calf RFI > mean + 0.5 SD), low (calf RFI < mean - 0.5 SD), and medium (calf RFI between mean ± 0.5 SD; SD = 2.1 kg). High and medium RFI group estimates were higher ($P < 0.001$) for daily feed intake and feed conversion ratio, and lower ($P < 0.001$) for average daily gain and final weight than those of the low RFI group.

Key Words: Cattle, Feed Intake, Multibreed

W37 Regression of feed intake on selected environmental factors for beef bulls during postweaning feedlot performance tests. G. T. Tabler*, A. H. Brown, Jr., E. E. Gbur, Jr., I. L. Berry, Z. B. Johnson, D. W. Kellogg, and K. C. Thompson, *University of Arkansas*, *Fayetteville*.

Selected weather data were analyzed to identify and quantify effects on feed intake of performance-tested beef bulls. Feed intake data originated from bulls (n = 1,874) in University of Arkansas Cooperative Bull Tests during 52 trials from 1978 to 1990. Bulls were given a 21-d adjustment period then individually full-fed a total mixed ration twice daily in the same stall for 140 d. Initial weight and age were recorded at start of each test with weights taken at 28-d intervals. Selected environmental variables used in the final analysis included maximum temperature, relative humidity, barometric pressure, rainfall, day length and wind speed. Data were pooled, divided into five 28-d periods with each period analyzed separately using all animals over all tests. Principal component analysis was used to reduce number of independent variables in the regression and overcome collinearity associated with numerous weather-related variables. Initial age and weight were included in principal components (PCs) regression as independent variables to adjust for initial animal differences. Feed intake was influenced by five PCs representing initial weight, initial age, maximum temperature, day length, rainfall, relative humidity, barometric pressure and wind speed throughout the study. Regression coefficients for initial weight and initial age were positive for each period on trial. Coefficients for environmental factors on feed intake ranged from positive to negative during various periods throughout the study. No single environmental variable had a consistent effect throughout all five periods. Results indicated numerous environmental factors influence feed intake throughout a feeding period and effects may vary as feeding period progresses, increasing the difficulty of accurate feed intake predictions.

Key Words: Beef Cattle, Day Length, Feed Intake

W38 Genetic parameters for growth traits and their relationships with yearling wool weight in Baluchi sheep breed of Iran. A. Kamali*[1], H. R. Mirzaee[1], H. Naeemipour[2], A. Delghandi[3], and H. Farhangfar[2], [1]*Zabol University*, *Zabol, Iran*, [2]*Birjand University*, *Birjand, Iran*, [3]*Jihade Agriculture*, *Mashhad, Iran*.

In this study heritabilities of and genetic correlations among birth weight (BWT), weaning weight (WWT), pre-weaning average daily gain (ADG0-3) and yearling wool weight in Baluchi sheep breed of Iran were estimated. Data were a total of 4099 records collected from a flock of Baluchi sheep breed in Abbas Abad breeding center located in northeast of Mashhad. Analyses were carried out applying restricted maximum likelihood statistical method using univariate and bivariate animal models. Heritability estimates for BWT, WWT, ADG0-3 and yearling wool weight in the univariate analyses were found to be 0.074, 0.03, 0.172 and 0.075 respectively. In the univariate analyses, direct and maternal additive genetic and environmental random effects as well as fixed effects of year, season of lambing, sex, birth type and age of dam (linear and quadratic covariates) were included. Based on bivariate analyses, genetic correlations among growth traits were 0.069 between BWT and WWT, 0.995 between WWT and ADG 0-3. Wool weight had high positive genetic correlations with BWT (0.899), WWT (0.647) and ADG 0-3 (0.737) suggesting that a correlated response would be expected for yearling wool weight as the direct genetic selection is practiced based upon weight traits.

Key Words: Baluchi Sheep, Growth Traits, Wool

W39 Estimation of genetic parameters for pre and post weaning average daily gains in a flock of Iran-black sheep breed of Iran. H. Farhangfar*[1], M. H. Molaee[2], and H. Naeemipour[1], [1]*Birjand University*, *Birjand, Iran*, [2]*Zabol University*, *Zabol, Iran*.

In this study a total of 1068 growth records obtained from Iran-black sheep breed (a synthetic breed resulted from crossing between Baluchi and Chios breeds) covering the period from 1988 to 2002 was used to estimate direct and maternal heritabilities for pre and post weaning average daily gains as well as genetic and environmental correlations between the traits under consideration. The number of lambs, sires, dams and total animals in the pedigree file were 1068, 56, 526 and 1496 respectively. The average daily gains for pre (0-3 months) and post weaning (3-6 months) ages were 188 g and 87 g respectively. AI-REML algorithm in a bivariate animal model was used to estimate genetic, permanent and temporary environmental variance and covariance components utilizing DMU package. In the model, systematic environmental factors of year and month of birth, sex, birth type, covariate of dam age, covariate of lamb age at weighing, and random effects of direct and maternal additive genetic as well as maternal permanent environment were included. For both traits, the covariance between direct and maternal genetic effects was assumed to be nonzero in the bivariate animal model. Direct and maternal heritability estimates for pre weaning average daily gain were 0.037 and 0.132 respectively and the corresponding figures for post weaning average daily gain were 0.007 and 0.017 respectively. Direct additive genetic correlation between pre and post weaning daily gains was -0.253. The results showed that for pre and post weaning daily gains, direct and maternal genetic effects were positively correlated (0.992 and 0.126 respectively). Permanent and temporary environmental correlations between pre and post weaning daily gains were found to be 0.579 and -0.231 respectively.

Key Words: Iran-Black Breed, Average Daily Gain, Genetic Parameters

W40 Genetic analysis of birth and weaning weights in a flock of Iran-black sheep breed of Iran. H. Farhangfar*[1], M. H. Molaee[2], and H. Naeemipour[1], [1]*Birjand University*, *Birjand, Iran*, [2]*Zabol University*, *Zabol, Iran*.

To estimate genetic parameters and genetic trends for birth and weaning weights in a flock of Iran-black (a synthetic breed resulted from crossing between Baluchi and Chios breeds) sheep breed of Iran, a total of 1362 weight records collected during 1988-2002 was used. The number of lambs, sires, dams and total animals in the pedigree file were 1362, 56, 612 and 1876 respectively. The average birth and weaning weights were 3.63 Kg and 19.91 Kg respectively. Genetic, permanent and temporary environmental variance and covariance components were estimated using AI-REML algorithm in a bivariate animal model consisted of the environmental factors of year and month of birth, sex, birth type, covariates of dam age (for both traits) and

lamb age at weaning (for weaning weight only), and random effects of direct and maternal additive genetic as well as maternal permanent environment. The covariance between direct and maternal genetic effects was assumed to be nonzero in the animal model. The analysis was undertaken by DMU package. Direct and maternal heritability estimates for birth weight were 0.072 and 0.097 respectively and the corresponding figures for weaning weight were 0.067 and 0.094 respectively. The additive genetic correlation between birth and weaning weights was found to be 0.936. The results showed that direct and maternal genetic effects for birth weight were negatively correlated (-0.032) while there were positively correlated (0.908) for weaning weight. Regression analysis of average predicted breeding value of lambs on year of birth indicated that there were no statistically significant annual increases at genetic level for both traits over the period of study.

Key Words: Iran-Black Breed, Heritability, Genetic Trend

W41 Estimation of genetic parameters for early growth traits in the Mehraban sheep using different models. P. Zamani*[1] and H. Mohammadi[2], [1]*Bu-Ali Sina University*, *Hamedan, Iran*, [2]*Agricultural-Jahad Organization*, *Hamedan, Iran*.

Genetic parameters for birth weight (BW), weaning weight (WW) and pre-weaning daily gain (PWDG) in Iranian Mehraban sheep were estimated using Restricted Maximum Likelihood (REML) procedure. Six different animal models were fitted, differentiated by including or excluding maternal effects and with and without covariance between maternal and direct genetic effects. The direct heritability estimates (h^2) ranged from 0.26 to 0.53, 0.18 to 0.32 and 0.15 to 0.33 for BW, WW and PWDG, respectively. The estimates were substantially higher when maternal effects, either genetic or environmental, were ignored from the model. The maternal heritability (h^2m) for BW was 0.25 when only maternal genetic effect was fitted in the model as second random effect. It was decreased to 0.14 when the maternal permanent environmental effect was added to model. More complete models resulted in more accurate estimations.

Key Words: Mehraban Sheep, Early Growth Traits, Genetic Parameters

W42 Application of logistic regression model to estimate phenotypic trend for twining trait of Baluchi sheep in Abbasabad breeding station of Mashhad. H. Farhangfar*[1], M. Molaee[2], and H. Naeemipour[1], [1]*Birjand University*, *Birjand, Iran*, [2]*Zabol University*, *Zabol, Iran*.

Twining, as a trait associated with prolificacy in sheep, has long been recognised of economic importance which is usually expressed in a binary mode and discrete phenotypic distribution. For analysis of twining in a given population, usual statistical methods which are based upon normality distribution of the variable cannot be used but instead generalized linear models should be applied. In the present research, in order to study some environmental factors (year of lambing, dam age and lamb birth weight) affecting on twining and to estimate phenotypic trend a total of 5100 birth records belonging to 1681 ewes lambing from 1984 to 2003 in a large flock of Baluchi sheep breed in Abbasabad breeding station of Mashhad was used. Only the records of singles and twins were used in this study. The average ewe age and birth weight of lambs were 2.79 years and 4.25 Kg respectively. Twining information was analyzed by a logistic regression using GENMOD procedure of SAS programme. The results obtained showed that year of lambing, dam age at lambing and lamb birth weight had statistical significant effect on the probability of twining. The probability of twining had a positive correlation with dam age while it was negatively correlated with lamb birth weight suggesting that birth weight of individual lambs born from twin-lambing ewes is expected to be lower as compared to lambs born from single-lambing ewes. The results also revealed a positive significant phenotypic trend for the probability of twining over the period of 20 years which was estimated to be 0.01 per year of lambing.

Key Words: Baluchi Sheep, Twining, Logistic Regression

W43 Genetic parameters estimation of Cashmere production for an indigenous goat in southern Khorasan province of Iran by using a repeatability model. H. Naeemipour*, H. Farhangfar, M. R. Asghari, and M. Bashtani, *Birjand University*, *Birjand,Iran*.

A total of 1490 Cashmere production records obtained from 567 indigenous goats in southern Khorasan province of Iran was used to estimate genetic parameters. Data were collected between 2000 and 2003. A single trait repeatability animal model in which fixed effects of sex, birth type, year of shearing and lamb age (linear and quadratic covariates) as well as additive genetic and environmental random effects were included. (Co) variance components were estimated by restricted maximum likelihood procedure using Powel algorithm applied in DFREML software. The results revealed that the estimates of heritability and repeatability of Cashmere production were 0.16 and 0.53 respectively indicating that a large proportion of total phenotypic variance is contributed by temporary environmental variation.

Key Words: Goat, Cashmere, Genetic Parameters

W44 Effect of genotype on characteristics of porcine aortic valves and bovine pericard as substitute heart valves. S. De Smet*[1], W. Deklerck[1], E. Claeys[1], G. Van Nooten[2], and K. Narine[2], [1]*Laboratory for Animal Nutrition and Animal Product Quality, Department of Animal Production, Ghent University*, *Melle, Belgium*, [2]*Department of Cardiac Surgery, University Hospital Ghent*, *Ghent, Belgium*.

Porcine aortic valves and bovine pericardium are frequently used as bioprosthetic heart valves. However, the life span of these valves is limited due to calcification and structural failure. Characteristics of the original fresh tissue in relation to the animal genotype may be involved in this life span variability. The aim of this study was therefore to measure some compositional and structural (stress test) characteristics of porcine aortic valves and bovine pericardium in genotypes widely differing in morphology and muscle physiology. Slaughter pigs of different sex, stress genotype and IGF2 genotype were sampled. Pericardium was taken from double-muscled Belgian Blue young bulls and culled cows, and from dairy cows. Bovine pericardium contained more total collagen ($P<0.001$), soluble collagen ($P<0.05$) and less uronic acid ($P<0.001$) compared with porcine valve leaflets.

The maximum load, extension and stiffness of bovine pericardium were more than twice as high (P<0.001). There were few differences between slaughter pig genotypes. Valve leaflets from stress positive pigs had a higher soluble collagen content and a lower uronic acid content compared to those from stress negative pigs (P<0.05). The uronic acid content was slightly higher in barrows compared to gilts (P<0.01). There were no differences in the pericardium characteristics of different cow types. However, soluble collagen content, extension and maximum load were all higher (P<0.001) in young slaughter bulls compared to culled cows. Consideration of the animal genotype might be warranted in studying the relationship between properties of fresh tissue and the durability of a bioprosthesis.

Key Words: Heart Valve, Pig, Cattle

W45 Response to genetic selection for *longissimus*color in Landrace swine: Status following two generations of selection. A. C. Naber*, K. M. Brueggemeier, S. J. Moeller, H. N. Zerby, and K. M. Irvin, *The Ohio State University*, *Columbus*.

The objective of the study was to measure response to selection for decreased longissimus Minolta L* (L) color in a population of Landrace swine. The population was established in 2002 from females obtained from 13 herds and males from 17 different genetic lines. Populations were established in two seasons (January and July farrowing) within a year. Two generations of random mating preceded separation of the populations, within season, in the year 2004 into Select (S; selected for darker loin L) and Control (C, Average EBV for loin L) based on an estimated breeding value (EBV) for L in candidate males. Available female litter mates were split into S and C randomly. After initial designation, the S and C populations were closed within a season and generations did not overlap. Selection in subsequent generations was focused on the male, and based on EBV for L. Matings within S and C were assigned randomly, while attempting to minimize full- and half-sib matings. Animal model EBVs were calculated based on sibling date within a replicate and using MTDFREML for L. Average EBVs of parent males, across seasons, for S and C in 2004 were -1.50 and 0.52 units, and in 2005 were -1.59 and 0.17 units, respectively. Responses, following two generations of selection, were evaluated using a mixed model with a fixed effect of treatment (S or C) and random harvest group within season for quality measures and season for measures of growth and carcass traits. Results indicate that S and C populations were not different for L (P = 0.18), although numerically, L was 1.0 unit less (darker) in the S population. After two generations of selection, S pigs had less (P < 0.01) loin area and greater days to 113 kg, with a trend for fatter 10th rib backfat (P < 0.08) than C pigs. No differences were observed between C and S pigs for visual loin color, marbling or loin shear force following two generations of selection. Heritability of L was estimated to be 0.36, providing a strong genetic basis for differentiation of the S and C lines if selection is effective in forthcoming generations.

Key Words: Swine, Selection, Pork Quality

W46 Genetic parameters for different measures of feed efficiency and their relationships with its component traits in Duroc pigs. M. A. Hoque*[1], K. Suzuki[1], H. Kadowaki[2], and T. Shibata[2], [1]*Tohoku University*, *Miyagi, Japan*, [2]*Miyagi Prefecture Animal Industry Experiment Station*, *Japan*.

Genetic parameters for feed efficiency traits on 380 boars and their component traits on 1642 pigs (380 boar, 868 gilts, and 394 barrows) in 7 generations of Duroc population were estimated with REML. Feed efficiency traits were included feed conversion ratio (FCR) and residual feed intake (RFI), and their component traits were daily gain (DG), metabolic body weight (MWT), and daily feed intake (FI). Three measures of RFI were calculated as the difference between actual and expected feed intake. They were calculated by the residual of phenotypic (RFI_p) and genetic (RFI_g) regressions from the multivariate analysis of FI on MWT and DG, and by the difference between actual feed intake and predicted nutritional requirement (RFI_n). The mean values for RFI_p and RFI_g were close to zero (-0.05 and -0.03 kg/day, respectively), and for RFI_n was negative (-0.11 kg/day). Most of the traits studied were moderately heritable (ranging from 0.34 to 0.53), except for FCR, which was low (0.27). The genetic and phenotypic correlations between DG and FI were high (0.77 and 0.51, respectively), while between MWT and FI were low (0.26 and 0.14, respectively). The corresponding correlations between RFI_p and RFI_g were above 0.95 implying that they might be regarded as the same trait. The genetic and phenotypic correlations of FCR with different measures of RFI were high but lower than unity. RFI_p was phenotypically independent of its component traits, MWT (r_p = 0.01) and DG (r_p = 0.03). RFI_g was genetically independent of MWT (r_g = -0.04), whereas there was a weak genetic relationship (r_g = 0.15) between RFI_g and DG. RFI was more heritable than FCR, and the genetic and phenotypic correlations of RFI_p and RFI_g with FI were positive and stronger than of FCR with FI. These results provide evidence that RFI_p or RFI_g should be included for genetic improvement of feed efficiency in Duroc pigs breeding program.

Key Words: Duroc Pigs, Feed Efficiency, Genetic Parameters

W47 Genetic parameters for carcass traits and their genetic relationships with feed efficiency traits in Duroc pigs. M. A. Hoque*[1], K. Suzuki[1], and T. Oikawa[2], [1]*Tohoku University*, *Miyagi, Japan*, [2]*Okayama University*, *Japan*.

Genetic parameters for carcass traits on 1642 pigs (380 boar, 868 gilts, and 394 barrows) and their genetic relationships with feed efficiency traits on 380 boars in 7 generations of Duroc population were estimated. Carcass traits were backfat thickness (BFT), loin eye muscle area (EMA), intra-muscular fat (IMF), and meat tenderness (MTR). Feed efficiency traits included feed conversion ratio (FCR) and residual feed intake (RFI). Three different measures of RFI, i.e., phenotypic (RFI_p), genetic (RFI_g), and nutritional (RFI_n) RFI were calculated by the difference between actual and predicted feed intake. The RFI_p and RFI_g were estimated, respectively, by the residual of phenotypic and genetic regressions of FI on MWT and daily gain. The RFI_n was estimated by the difference between actual and expected feed intake that predicted by the nutritional requirement. The heritability estimates for all the carcass traits were moderate (ranged from 0.38-0.46), except for BFT, which was high (0.72). Measures of RFI were positively correlated with IMF (r_g=0.14, 0.17, and 0.18 for RFI_n, RFI_p, and RFI_g, respectively), and negatively correlated with EMA (r_g=-0.61, -0.57, and -0.56 for RFI_n, RFI_p, and RFI_g, respectively). The genetic correlations of feed efficiency traits (FCR and all the measures

of RFI) with BFT were favorable (positive). BFT was more strongly correlated with RFI ($r_g \geq 0.76$) than with FCR ($r_g = 0.58$). Selection responses in feed efficiency traits through selection for daily gain, EMA, BFT, and IMF were small but in the desired direction, i.e. breeding values for feed efficiency traits decreased as selection generation progressed. Large responses in IMF and weak responses in EMA, BFT and MTR would be expected. This study provides evidence that selection against either RFI_p or RFI_g would give similar correlated response in carcass traits.

Key Words: Carcass Traits, Feed Efficiency, Genetic Relationships

W48 Prediction of number born alive and weaning weight of litter in first parity using performance test traits in four breeds of swine. Z. B. Johnson*, *University of Arkansas*, *Fayetteville*.

The objective of this study was to examine relationships between performance test traits and subsequent reproductive performance in first parity females in four breeds of swine. Performance test records were collected in a commercial swine operation from 1992 to 1999. All females were grown to 100 d of age. At this time pigs were weighed (WT100) and selected for performance testing based on a combination of maternal and performance indexes which were different for each breed. Pigs were weighed at the end of the 77-d performance test and ADG calculated. Backfat (BF), loin eye area (LEA), and body length (LEN) were measured. Number of live born pigs (NBA) and weight of litter at weaning (WWL) were recorded. Regression analyses were used to determine if NBA and WWL could be predicted using previous performance test records of the dam. Regression models included effects for contemporary group of the dam, maternal grandsire, and sire of the litter, and WT100, ADG, LEA, BF, and LEN as covariates. In Landrace, ADG was a significant covariate ($P = 0.02$) for NBA. For Yorkshire, LEN was a significant ($P < 0.01$) covariate for NBA; ADG ($P = 0.06$) and LEA ($P < 0.01$) were significant covariates for WWL. In Duroc, WT100 ($P < 0.01$) and LEN ($P = 0.02$) were both significant covariates for NBA, while LEN ($P = 0.03$) was a significant covariate for WWL. In Hampshire ADG was a significant ($P = 0.05$) covariate for NBA, and WT100 ($P < 0.01$), ADG ($P = 0.01$) and BF ($P = 0.03$) were significant covariates for WWL. Regression models accounted for 37 to 59 % of the variation in NBA and WWL; however, the majority of this variation was due to contemporary group, maternal grandsire and sire of the litter. No covariate alone contributed more than 1% to the total variation in NBA or WWL, implying that while significant ($P < 0.05$) relationships did exist these covariates would probably not be useful in predicting these litter traits.

Key Words: Litter Size, Weaning Weight, Performance Test Traits

W49 Estimation of the additive and dominance variances in SA Landrace pigs. D. Norris*[1], L. Varona[2], D. P. Visser[3], H. E. Theron[3], and S. F. Voordewind[3], [1]*University of Limpopo*, *Polokwane, South Africa*, [2]*Center UDL-IRTA*, *Lleida, Spain*, [3]*ARC-Animal Improvement Institute*, *Irene, South Africa*.

The objective of this study was to estimate dominance variance for number born alive (NBA), interval between parities (FI) and 21- day litter weight (LWT21) in South African Landrace pigs. A total of 26223 NBA, 16370 FI and 21335 LWT21 records were analysed. Bayesian analysis via Gibbs sampling was used to estimate variance components and genetic parameters were calculated from posterior distributions. Estimates of additive genetic variance were 0.669, 43.46 $d^2$and 9.02 kg^2 for NBA, FI and LWT21, respectively. Corresponding estimates of dominance variance were 0.439, 123.68 d^2 and 2.52 kg^2, respectively. Dominance effects were important for NBA and FI. Permanent environmental effects were significant for FI and LWT21 It may be beneficial to evaluate non-additive genetic merit of individuals and families in addition to their transmitting abilities. A breeding program that capitalizes on non-additive genetic merit may be desirable.

Key Words: Non-Additive Genetic Effects, Bayesian Analysis, Genetic Parameters

W50 EpiSNP: A computer package for genome-wide analysis of SNP epistasis and single-locus effects of quantitative traits. L. Ma*, D. Dvokin, J. R. Garbe, and Y. Da, *University of Minnesota*, *St. Paul*.

The EpiSNP computer package is designed for genome-wide analysis of SNP epistasis and single-locus effects on quantitative traits and is applicable to all bi-allelic candidate genes. The statistical tests were based on an extended Kempthorne model that allows Hardy-Weinberg disequilibrium and linkage disequilibrium for genome-wide single-locus testing and pairwise epistasis testing of potentially large numbers of SNPs. The package currently has four individual programs. The main program, EPISNP, offers tests of three single-locus effects, SNP marker effect, additive and dominance effects, and tests of five pairwise effects, two-locus interaction, additive x additive, additive x dominance, dominance x additive, and dominance x dominance epistasis effects. The CPUHD program estimates the CPU time and disk space required to execute the EPISNP program, the EPISNPPLOT program produces graphical views of single-locus significant results and sample sizes for each chromosome, and the EPINET program draws figures of epistasis networks. The EpiSNP computer package including the user manual is freely available at http://animalgene.umn.edu.

Key Words: SNP, Genome-Wide Association, Epistasis

W51 SPSSQTL: A computer program for calculating statistical power and sample size for QTL and candidate gene detection. J. R. Garbe*, L. Ma, and Y. Da, *University of Minnesota*, *St. Paul*.

The SPSSQTL computer program offers calculations of statistical power and sample size for detecting two single-locus effects (additive and dominance) and four epistasis effects (additive x additive, additive x dominance, dominance x additive, and dominance x dominance) of a QTL or a candidate gene. The program consists of one dialog box with fields for the user to enter parameter values for calculating statistical power or sample size. For detecting additive and dominance QTL effects, the user has a choice of F-2 or reciprocal backcross (RBC) design. For detecting epistasis QTL effects, the F-2 design is assumed. To calculate statistical power, the user needs to enter parameter values of QTL heritabilities (measures of QTL effect size), type-I error, recombination frequency between the marker and QTL, and sample size. To calculate sample size, the user needs to enter

statistical power in addition to all the above parameter values except sample size. Changing any field in the dialog box will cause the calculated power or sample size to be updated. For candidate gene testing, power and sample size are calculated by setting the marker-QTL recombination frequency to zero. The program including the user manual is freely available at http://animalgene.umn.edu.

Key Words: Statistical Power, Sample Size, QTL

W52 The effect of two freezing rates and two equilibration times on semen post-thaw motility of bad freezer bulls. G. Rocha-Chavez[1], J. M. Tapia-Gonzalez[1], J. G Michel-Parra[1], M. A. Pinto-Jacobo[2], and G. Gonzalez-Guerra*[1], [1]*CUSUR Univ de Guadalajara*, *Cd Guzman, Jalisco, Mexico*, [2]*URPJ*, *Guadalajara, Jalisco, Mexico*.

It is a well known fact that beef cattle living in tropical areas tend to have low freezability on their semen intended for artificial insemination. The objective of this study was to determine the effect of two freezing rates and two equilibration times on post thaw motility of low freezability semen. Each ejaculate from six bulls known as bad freezers was diluted 1:1 with Andromed® extender, split in four parts and allocated in a 2x2 factorial arrangement into one of the following experimental groups: (1) semen equilibrated for 4 hr and slow freezing rate (FR); (2) semen equilibrated for 4 hour and fast FR; (3) Semen equilibrated for 24 hr and slow FR; (4) semen equilibrated for 24 hr and fast FR. Each of the six bulls (3 simmental and 3 brahaman) was collected 10 times and semen was frozen on 0.5 cc straws using a standard protocol. Equilibration was made at 4°C and freezing rates were 0.5°C/min and 4°C/min for low and fast respectively. Motility readings were made on thawed semen after being frozen for at least a 24 hr period. All readings were made in duplicate using video recording technology and descriptive statistics was used for initial arrangement of data. The chi squared procedure was used for finding differences between treatments. Readings on post-thaw motility of 47 ± 7.7, 52 ± 5.6, 58 ± 3.2 and 49 ± 6.3 % were found for treatments 1, 2, 3, and 4 respectively with no statistical differences between treatments except for group 3 ($P<0.05$). No interaction between breeds and treatment was found. It was concluded that, under conditions of this study, longer equilibration periods and slower freezing rates are beneficial for semen of low freezability.

Key Words: Semen, Freezability, Bulls

W53 Effect of selection for increased egg production, age, and sex on turkey breast muscle development. C. S. Coy*, K. E. Nestor, and S. G. Velleman, *Ohio Agricultural Research and Development Center, The Ohio State University*, *Wooster*.

Genetic selection plays an important role in breast muscle development in turkeys. Previous studies have shown a correlation between growth selection and altered breast muscle morphology leading to muscle fiber damage. In a recent study, genetic selection for increased egg production showed no significant changes in breast muscle morphology from 8 to 16 wk of age between a line (E) selected for increased egg production and its randombred control line (RBC1). However, there was a significant interaction between line and age suggesting that the E and RBC1 line may develop differently. Morphological structure of the breast muscle was better in males than females. The purpose of this study was to examine breast muscle morphology changes in the E and RBC1 lines during key stages of muscle development. Breast muscle morphology was observed at embryonic d 25, and 1, 4, 8, 16, and 20 wk posthatch in the E and RBC1 lines. Breast muscle samples from 10 birds per age-line-sex subgroup were collected, fixed, processed, embedded in paraffin, sectioned, and stained with hematoxylin and eosin. Representative muscle sections from each bird were scored by 4 individuals based on breast muscle morphology. Scores ranged from 1 (little extracellular space and indistinct muscle fibers) to 5 (large extracellular space and distinct muscle fibers). Posthatch breast muscle morphology scores did not differ between the E and RBC1 lines, but age and sex differences were significant. The morphological scores were best at embryonic d 25 but declined significantly at 1 wk posthatch. Scores improved significantly from 1 to 4 wk posthatch and remained constant through 20 wk posthatch. Males had higher scores than females. The results of this and previous studies suggest that selection for increased egg production may be associated with a slight reduction in breast muscle morphology scores at 16 wk of age.

Key Words: Turkey, Genetic Selection, Muscle

W54 Sequence homology comparison between goose and chicken liver cDNA libraries. Y. H. Wang*[1], E.-C. Lin[1], M. C. Hsu[2], C. Y. Lien[1], B. T. Tsai[1], C. F. Yen[1], H. W. Lin[1], S. T. Ding[1], W. T. K. Cheng[1], K. T. Yang[3], M. C. Huang[3], Y.-H. Fan[3], S.-H. Chiou[3], C. F. Chen[3], Y. P. Lee[3], [1]*National Taiwan University*, *Taipei, Taiwan*, [2]*National Taitung Junior College*, *Taitung, Taiwan*, [3]*National Chung Hsing University*, *Taichung, Taiwan*.

The DNA sequence information of goose is very limited in the public databases. In this study, we utilized expressed sequence tags (ESTs) of goose and chicken liver cDNA libraries for sequence homology comparison. The goose and chicken cDNA libraries were constructed by using livers from 4 Taiwanese native chickens and 6 White Roman geese. There were totally 2,400 and 6,686 clones sequenced in the goose and chicken liver cDNA libraries, respectively. After excluding sequences with low quality, short and low complexity, 8,403 high quality sequences (2,075 of goose; 6,328 of chicken) were clustered and assembled using tgicl package (from TIGR website) with minimum requirements of 65 base pairs overlapping and 95% similarity. Totally 605 clusters (≥2 sequences per cluster reaching the requirements, averaging 9.3 sequences per cluster) were found with 636 contigs assembled in those clusters. The number of clusters with sequences from both of goose and chicken was 29, which are highly similar in the cDNA sequences between the two species. There were 14 clusters which have different contigs per cluster assembled from either goose or chicken sequences only. Such clusters might represent certain differences happened in the same gene between goose and chicken. To assist the comparison of sequence homology, the remaining clusters were searched against NCBI NT database using blastn. There were 76 clusters annotated to be 35 gene identities, which indicated more variation of sequence in such clusters than the previous two categories. However, the other 486 clusters could not be classified that might result from the lack of enough sequence information from goose. This comparison might provide more information for the further genomic studies of goose.

Key Words: Goose, Chicken, Sequence Homology

W55 Combining ability of characteristics of egg quality of quail for analyze system of diallel crossbreds. A. Piccinin, J. N. Gimenez, C. H. M. Malhado, C. Móri, C. Andrighetto, R. M. S. Emediato*, S. A. Maestá, A. A. Ramos, H. C. Gonçalves, and E. N. Martins, *São Paulo State University*, *Botucatu, São Paulo, Brazil*.

The goal of this trial was to indicate crossbreds to improve quality of eggs of quail. It was used a system of diallelic crossbreds between three ancestries. Effect of general capacity of combination, specific capacity of combination and reciprocal effect have been estimated. It was studied characteristics as specific gravity, height of albumen, Haugh unit, egg yolk percentages, shell and albumen. Ancestries 1 and 2 have improved the indices of specific gravity, and ancestry 3 improved the percentage of egg shell and consequently shelf-life, when the general capacity of combination is considered. lineages of crossbred 1x2 was more efficient for Haugh unit and albumen height, indicating bigger shelf-life of these eggs. Lineages of the crossbred 1x3 and 2x3 have shown to be the best option for specific gravity and percentage of egg shell, respectively, which resulted in better egg quality. The reciprocal effect have shown significant in the majority of the characteristics, in the partial periods. Crossbreds between males of ancestry 2 with females of ancestry 1 have provided lineages with bigger height of albumen, Haugh unit and percentage of egg shell, and males of ancestry 3 with females of ancestry 2 have provided lineages with bigger specific gravity, percentage of egg yolk and egg shell. Both crossbreds can be used in programs of genetic improvement aiming get better internal quality of eggs.

Key Words: Diallelic Crossbreds, Egg Quality, Quail

W56 Long-term effects on the expression of the intestinal Na-P type IIb cotransporter in broilers fed phosphorus deficient diets early in life. C. M. Ashwell*[1] and R. Angel[2], [1]*North Carolina State University*, *Raleigh, NC*, [2]*University of Maryland*, *College Park, MD*.

To determine the effects of dietary P on the expression of the chicken intestinal Na/Pi type IIb cotransporter (NaPcoT) experimental diets were formulated to be deficient in P. Male Ross 308 chicks were fed either a control (C) consisting of 1.11% Ca and 0.50% available P or a low (L) diet containing 0.59% Ca and 0.25% available P from hatch to 4 d of age (90hr). All birds were then fed a C diet consisting of NRC recommended levels of Ca and P until d 22. From d 22 to d 38 the birds were either maintained on a C (0.7%Ca and 0.3%P) or an L diet (0.4% Ca and 0.12% P). The three dietary treatments, C-C-C, C-C-L, and L-C-L met all other NRC (1994) nutrient recommendations. Performance data were collected for each dietary phase including weight gain, feed conversion, bone ash, and specific nutrient retention. RNA extracted from each of the regions of the small intestine were reverse transcribed to produce cDNA and analyzed by real-time PCR for the levels of both the NaPcoT mRNA and 18s rRNA. The effect of dietary treatment was determined by analyzing the resulting Ct values for each amplification and determining the $\Delta\Delta$Ct using the level of 18s rRNA as an internal standard for normalizing the amount of RNA in each reaction. The reduction of P in the post hatch diet had a significant effect on the expression of the NaPcoT by stimulating an average 2.8-fold increase in the mRNA levels in the small intestine. The most interesting aspect of this effect of diet on expression of NaPcoT in the intestine is the increase in expression levels later in life (d38) of the birds that experienced the low P diet for the first 90 hr post-hatch in comparison to the controls. This data correlates well with the apparent increase in efficiency of nutrient uptake measured in these birds. This clearly establishes that 'imprinting' or permanent modifications are occurring in the animal post-hatch that are long term and allow for significant increases in NaPcoT expression and improved P utilization when P deficient diets are fed in the grower/finisher phases.

Key Words: Gene Expression, Conditioning, Imprinting

W57 Analysis of expressed sequenced tags from abdominal muscle cDNA library of the pacific white shrimp *Litopenaeus vannamei*. J. Cesar, B. Zhao, and J. Yang*, *University of Hawaii*, *Honolulu*.

As the shrimp industry expand rapidly worldwide, the pacific white shrimp, *Litopenaeus* vannamei, is becoming an economically important species in aquaculture. Along with culture technology and disease resistance, genetic enhancement of growth rate is an important aspect of shrimp aquaculture. Although abdominal muscle accounts for 90% of shrimp meat, little is known about the shrimp muscle genes, particularly the muscle regulatory genes. To identify the critical genes responsible for shrimp muscle growth and metabolism, we established a cDNA library based on juvenile abdominal muscle by a PCR-based SMART^{TM} cDNA technology. Library size was 5.0 x 10^6 pfu independent clones per microgram of starting DNA vector with the percentage of recombinant clones >95%. Single pass sequence analysis of 311 randomly picked positive clones revealed 197 expressed sequence tags with average insert size of 745 nucleotides. BLASTn searches using the sequences identified 161 unique clones, including 45 high (>98%) identity matches to previously identified genes; 36 medium (80% to 98%) identity matches (>100 bits hit score and <2 x 10^{-19} E-value); 76 unknown sequences; 2 sequences matching hypothetical protein sequences, 2 sequences matching DNA microsatellite markers with short TG, GA and CAA repeats in the database. Among the 45 high identity-matched ESTs, 12S ribosomal RNA, actin 1, actin 2 and arginine kinase and beta-actin were most abundant with 5 to 13 clones each. Primary hit sequences originate from shrimp, insects, mammal, lobsters, crabs, crayfish, and barnacle. According to the inferred or known functions of the gene products, genes were categorized as muscle structural proteins (28%), followed by unknowns (24%), protein synthesis (18%), enzymes (14%), carrier protein (6%), ion channel (2%), DNA replication (2%). In summary, more than 25% of the ESTs identified a new gene from the cDNA library supports full-scale EST strategy for discovery of the transcripts or genes that regulate abdominal muscle biology. A further analysis and identifications of the full-length cDNA sequences will significantly facilitate shrimp genomic program.

Key Words: cDNA Library, Expressed Sequence Tag, Shrimp

W58 Higher oxidative product in UHT drinking milk originated from milk powder than that from raw milk. S. Santinate, W. Suriyasathaporn, and P. Vinitchaikul*, *Chiang Mai University*, *Muang, Chiang Mai, Thailand*.

In Thailand, the most popular liquid milk product is UHT milk. In our UHT commercial milk, it is originated from 2 sources of milk including raw milk and milk powder, whereas the latter will be recombined with water. Autoxidation takes place throughout storage of the powder, especially during importing processes time interval. The most important secondary product of autoxidation is the malondialdehyde (MDA) that is usually used as an indicator of the lipid peroxidation process. This product imparts that the milk quality has been decreased including off-flavors and loss of nutrients. Therefore, the objective of this study was to determine whether UHT milk originated from raw milk (RAW) had lower MDA than that from milk powder (POW). In addition, interval to expiration date was controlled from MDA production during storage after UHT milk process. Four commercial UHT liquid milk products known for sources of milk were selected. Approximately 15 packages of each commercial milk product with variation of expiration dates were collected from markets. MDA were measured. Analysis of variance was used to test whether MDA of among UHT milk were different from one another. Pearson correlation coefficient was used to evaluate the relationship between interval to expiration date and MDA. Means and standard error of means from RAW1, RAW2, POW1 and POW2 were 1200 + 92, 1460 + 95, 1945 + 85 and 1848 + 79 ppb, respectively. Statistical analysis showed that RAW1 and RAW2 were different from POW1 and POW2 ($P<0.05$). Higher intervals to expiration date decreased MDA concentrations ($p = -0.23$, $P< 0.05$). This indicates that UHT milk has lower quality from milk powder than raw milk. Increasing storage times after production process is associated with increase of malondialdehyde concentrations.

Key Words: Malondialdehyde, UHT Milk, Raw Milk

W59 Effect of cold storage and packaging material on butter flavor. P. R. Lozano[2], R. E. Miracle*[1], A. J. Krause[1], K. R. Cadwallader[2], and M. A. Drake[1], [1]*North Carolina State University*, *Raleigh*, [2]*University of Illinois*, *Champaign-Urbana*.

Sweet cream butter in the United States is often stored for several months under refrigerated and frozen storage in bulk (25 kg blocks) and quarters (commercially-packaged sticks). Deterioration of flavor may occur during this time. The objective of this study was to evaluate the flavor of bulk and stick butter across frozen and refrigerated storage under different packaging conditions. Butter (bulk and quarters) was collected on two occasions from two West coast facilities. Two packaging materials (wax parchment paper and foil) were represented. Butters were stored at 4°C or -20°C and evaluated after 0, 6, or 12 months storage. Descriptive sensory analysis using a trained panel was used to document flavor changes. Volatile compounds of butter and packaging material were identified using dynamic headspace analysis (DHA), solid phase micro-extraction (SPME), and solvent assisted flavor evaporation (SAFE) followed by gas chromatography mass spectrometry (GC-MS) and gas chromatography olfactometry (GC-O). The most intense aroma-active volatile components of pasteurized AA butter were butanoic acid, d-decalactone, 1-octen-3-one, dimethyl trisulfide and diacetyl. Lipid oxidation products and methyl ketones increased as a function of storage time. Butter stored at refrigeration temperatures (4°C) showed greater flavor deterioration by sensory and instrumental analyses than butter stored at freezing conditions (-20°C). The intensity and relative abundance of styrene increased as a function of storage time at refrigeration temperature. Butter frozen for 12 months exhibited lower levels of styrene and a flavor profile more similar to fresh butter compared to butter refrigerated for 12 mo. Foil wrapping material performed better than wax parchment paper to prevent styrene migration to butter, in minimizing the increase in the intensity of lipid oxidation and hydroxyl acid products, and in the loss of fresh butter flavor.

Key Words: Butter, Storage Stability, Packaging

W60 Persistence of conjugated linoleic acid (CLA) on three dairy products. M. A. Rodriguez[1], P. Pellegrini[1], G. Muset[1], P. Gatti[1], D. A. Garciarena[2], and G. A. Gagliostro*[2], [1]*Instituto Nacional de Tecnología Industrial (INTI). Lácteos*, *Buenos Aires, Argentina*, [2]*Instituto Nacional de Tecnología Agropecuaria (INTA)*, *Balcarce, Argentina*.

The study was designed to test the persistence of 9-cis 11-trans CLA on yogurt, white cheese and pasteurized milk elaborated from raw milk of high CLA content (3.54 g/100g FA). Six Holstein cows (520 ± 60 kg liveweight) producing about 10 kg of milk grazed an oat pasture (2800 kg DM/ha; 11 kg pasture DM/cow) and received also a TMR composed by corn grain (1.3 kg DM/cow/d), corn silage (5.6 kg DM/cow/d), sunflower oil (0.8 kg/cow/d), fish oil (0.24 kg/cow/d) and sunflower meal (0.89 kg DM/cow/d). After 10 days of adaptation individual milk samples were collected and transformed into yogurt, white cheese and pasteurized milk reproducing industrial conditions. Fatty acid composition of milk and dairy products was analyzed by gas chromatography. Differences in CLA concentration between raw milk and products were stated using the T-test for paired observations. In the case of pasteurized milk, two different processes were carried out at 72 °C for 15 seconds (HTST) and at 140 °C for 5 seconds (UHT). Results showed an average increase of CLA of 0.08 g/100g (ranging from 0.02 to 0.11 g/100g) over raw milk ($P<0,11$) for HTST and 0.07 g/100g (-0.03 to 0.19 g/100g) for UHT ($P<0,93$). White spreadable cheese elaborated from HTST pasteurized milk after adding a mesophilic starter and chymosin showed a CLA increase of 0.04 g/100g ranging from -0.04 to +0.09 g/100g ($P<0.97$). The six elaboration trials of yogurt using HTST pasteurized milk and adding sugar, non-fat milk powder and starter showed an average decrease in CLA of 0.19 g/100g ranging from -0.45 to +0.15 g/100g ($P<0.88$). The results showed that variations in CLA content were not significant whatever the dairy product tested. In this study, the CLA present in the raw milk was not lost during the processes of milk transformations. Negative metabolic actions of the starter or heat affects on final CLA content in the products were not detected.

Key Words: Conjugated Linoleic Acid, Dairy Products, Pasteurized Milk

W61 Effects of refrigeration and calcium on whey protein aggregation. M. R. Costa*[1,2], G. Brisson[1], M. L. Gigante[2], P. S. Tong[1], and R. Jiménez-Flores[1], [1]*California Polytechnic State University*, *San Luis Obispo*, [2]*State University of Campinas*, *Campinas, Brazil*.

Aggregation of whey proteins in 5% protein solution was studied using a laser diffraction particle size analyzer. Two whey protein concentrate powders (WPC80) with similar composition were evaluated: WPC1 was produced by traditional commercial procedures, and for WPC2 the liquid whey protein concentrate (LWPC, obtained by ultrafiltration) was refrigerated (4°C, overnight) prior being spray-dried. We studied the effects of refrigeration, adding calcium (50mM $CaCl_2$) to each of the WPC solutions, and heating (50°C/8min). Our results show that WPC1 solutions did not have particles larger than 6µm initially. However, calcium addition produced large aggregates (10-60µm diameter) that became the main volumetric fraction (78.6±0.2%). Aggregation was independent of heating, and the formed aggregates did not change after either heating or overnight refrigeration. In the WPC2 solutions, calcium addition did not have the same pronounced impact on aggregate formation as in the WPC1 solutions. The main volumetric fraction in the calcium-added solutions switched from particles smaller than 2µm to particles between 2 and 10µm diameter (54.5±0.8%) only after heating. However, after overnight refrigeration these largest aggregates were partially disrupted into the smallest particles, which returned as the main volumetric fraction (58.6±0.7%). The addition of β-mercaptoethanol (0.1%) had no particle size distribution effect over the solutions, while the presence of urea (4M) changed the turbid solutions immediately to clearer ones. This suggests the contribution of non-covalent interactions to aggregates formation. In addition to the noticeable large aggregate formation, our results show that refrigerating the LWPC prior spray-drying reduced the proteins susceptibility to $CaCl_2$-induced aggregation in the reconstituted WPC. The aggregates formed in this solution after calcium addition were not too big and reversible by refrigeration, indicating they were held together by hydrophobic interactions. In contrast, the $CaCl_2$-induced aggregates from WPC manufactured without the refrigerating step were much larger and formed irreversible aggregates.

Key Words: Whey Protein Concentrate, Whey Protein Aggregation, Particle Size Distribution

W62 Seasonal variation of conjugated linoleic acid (CLA) and n-3 fatty acids of goat milk fat and its transfer into cheese. A. Nudda[1], G. Battacone[1], S. Testone[2], and G. Pulina*[1], [1]*Dipartimento di Scienze Zootecniche - Università di Sassari*, *Sassari, Italy*, [2]*Associazione Regionale Allevatori della Sardegna*, *Cagliari, Italy*.

The seasonal variation in conjugated linoleic acid (CLA), vaccenic acid (VA) and n-3 fatty acid contents in goat milk and the extent of their transfer from milk into cheese fat were investigated. Samples of milk and of the derived fresh cheese were collected in two milk processing plants located in middle-east Sardinia (Italy) every two weeks from early-spring (March-April) through early-summer (July). The concentrations of individual fatty acid in each sample of milk and cheese were determined by gas chromatography. Data were analyzed with a linear model that included the effect of processing plant, period and source (milk or cheese). Concentrations of CLA, VA and omega-3 fatty acids did not differ between milk and cheese (c9,t11 CLA content 0.62 and 0.67 mg/100 mg FA, VA content 1.09 and 1.06, and omega-3 content 0.88 and 0.79, respectively for milk and cheese). The FA composition of both milk and cheese was significantly affected by period of sampling: the mean of C18:3 n-3 concentration decreased linearly from early spring to early summer (0.91 vs 0.61 mg/100 mg FA). On the other hand, the means of VA and c9,t11 CLA decrease markedly from March (1.93 and 0.98, respectively) to April (1.03 and 0.66, respectively), and remain stable until early summer. A possible explanation for the different pattern of individual fatty acids can be found in the farming system of goat in this geographic area, where natural pasture and Mediterranean maquis scrubs represent the main feeding source. The reduction of C18:3 n3 in milk, for example, may reflect the reduced availability of grass, which is the main source of C18:3 n-3 fatty acid, that occurs in late spring-summer. No differences were observed between the two cheese plants for c9,t11 CLA and VA concentration in milk and cheese. *Acknowledgements: Research supported by the Ministry of University and Research (FISR grant).*

Key Words: Conjugated Linoleic Acid, Goat Milk, Cheese

W63 Survey of fluid milk quality. C. A. Boeneke*, K. J. Aryana, D. W. Olson, and J. L. Vargas, *Losuisiana State University Agricultural Center*, *Baton Rouge*.

Nineteen dairy processing plants located in the west, midwest, and southern regions of the U. S. were surveyed in order to determine milk quality. Whole, two percent, and skim milks were obtained in duplicate from the plants. Milk samples were shipped overnight to the Dairy Science Building at Louisiana State University. A temperature control was included with each set of samples. One set of milk samples were evaluated upon arrival for sediment, freezing point, lab pasteurization counts, coliform counts, standard plate counts, protein, fat, and somatic cells. Milks were evaluated for flavor using the Collegiate Dairy Products Evaluation Score Sheet. Milks were then stored at 7° C for two weeks. At the end of the two week period, milks were evaluated again for flavor by a 5 member trained panel. The entire experiment was repeated once every three months over a nine month period. Coliform counts on fresh samples were all less than ten colony forming units (CFU's) per ml. Standard plate counts ranged from less than 100 to 6300 CFU's per ml. No sediment was found in any of the samples. Samples received scores ranging from 8 to 9 out of 10 possible points for sensory evaluation upon arrival with the most common criticism being cooked. Sensory evaluation scores at the end of the two week period ranged from 1 to 9 out of 10. Common criticisms of samples were cooked, rancid, unclean, and fermented fruity. Region of the U. S. the samples were received from showed no differences in the quality of the samples.

Key Words: Shelf Life, Milk, Quality

W64 Effect of total protein content and whey to casein ratio on the texture of ice cream. J. M. Morton[1], P. Quok*[2], J. Estrade[1], W. Wang-Nolan[1], S. Vink[1], and P. S. Tong[1], [1]*Dairy Products Technology Center*, *San Luis Obispo, CA*, [2]*California Polytechnic State University*, *San Luis Obispo*.

Whey protein concentrate (WPC) is used in ice cream for its nutritional and functional properties. The functional properties of WPC enhance freeze-thaw stability and help minimize ice crystal formation, which

improve texture and mouthfeel. This study examined the effect of total protein content and whey to casein ratio (W/C) on the texture of ice cream. Regular (4.1%) and high (5.7%) protein ice creams were prepared with W/C levels of 1:1, 1:2, 2:1, and 4:1, for a total of 4 matched treatments and 1 matched control (no WPC). Nonfat dry milk and WPC 34 were used to adjust W/C and total protein content. Ice cream samples were tempered at -15°C for 4 to 6 hours before cutting. Twelve, 2.5 cm cubes were cut from the core of each ice cream block, positioned with the same surface facing up in covered serving cups, and stored at -18°C until testing the following day. Nine judges trained in descriptive analysis of ice cream evaluated the texture of the samples from first inspection, visual, to final mastication stage, chew down. Judges rated the intensities of each textural component on 15 cm line scales anchored by reference standards. Judges individually evaluated each sample in triplicate following a balanced block test design with a randomized, sequential monadic serving order. ANOVA of the data showed that when total protein content and W/C were accounted for, significant differences ($p \leq 0.05$) existed for hardness, rate of breakdown, rate of melt, and density. The high protein ice creams were less icy, softer, oilier, less foamy, and had higher mouthcoating than regular protein ice creams. Ice creams with the highest W/C were stickier, softer, foamier, and had higher rates of breakdown and melt. These findings suggest that both total protein content and milk protein composition affect ice cream texture.

Key Words: Ice Cream, Whey Protein, Sensory

W65 Influence of form of vitamins on yogurt characteristics. B. Dufrene*[1] and K. J. Aryana[2], [1]*Louisiana State University*, *Baton Rouge*, [2]*Louisiana State University Agricultural Center*, *Baton Rouge*.

Vitamins A and D are commonly added during the processing of some dairy products. Objective was to study the effect of liquid and powdered forms of vitamins A and D added separately during the manufacturing of yogurt. Vitamin A palmitate and Vitamin D_3 were incorporated at the rate of 1000 IU and 200 IU respectively per 8 oz of yogurt. Syneresis, pH, viscosity, color (L^*, a^* and b^*) sensory, lactic acid bacterial counts were enumerated on the yogurts at 0, 1, 3 and 5 weeks of storage. The treatment x storage time interaction effect was not significant for any of the attributes studied other than lactic acid bacterial counts. For lactic acid bacterial counts significant difference were noticed between vitamin D_3 liquid at weeks 0 and 5, vitamin A liquid at weeks 0 and 5, vitamin A powder at weeks 0 and 5, vitamin D_3 liquid and powder at week 0. There was no treatment effect for any of the characteristics studied. Storage time was significant for flavor appearance, body texture, L^* and a^*. As storage time increased to week 5 there was a significant drop in flavor and body texture compared to week 0. Lightness values significantly increased and a^* values significantly decreased at week 5 compared to week 0. The form of vitamin, liquid or powder, did not have any effect on the characteristics of yogurt.

Key Words: Vitamin, Form, Yogurt

W66 Effects of raw milk storage time and pasteurized milk storage temperature on milk shelf-life. G. B. Sanvido, D. Y. Kabuki, M. R. Costa*, and M. L. Gigante, *State University of Campinas*, *Campinas, SP, Brazil*.

The effects of psychrotrophic microorganisms development on pasteurized milk shelf-life were not a concern in Brazil until recently when raw milk cold storage start to be required by law in this country. This work evaluated the effects of raw milk storage time (0, 4 or 7 days at 5°C) and pasteurized milk storage temperature (5°C or 10°C) on its shelf-life. Milk was submitted to HTST pasteurization process (72°C/15sec), cooled at 5°C and then packaged in low-density polyethylene bags. Raw and pasteurized milk were initially analyzed by physicochemical (acidity, pH, total nitrogen, soluble nitrogen at pH 4.6 and TCA 24%) and microbiological analyses (standard plate, psychrotrophic microorganisms and Pseudomonas spp counts), and these parameter were monitored during storage of both raw and pasteurized milk. Raw milk also was initially analyzed for antibiotic presence and somatic cell count, and pasteurized milk for Coliform and Salmonella spp counts. Pasteurized milk shelf-life was defined as the time necessary to reach 8×10^4 ufc/mL on the standard plate count. A Split-split-plot design was used and the whole experiment was repeated three times. The longer raw milk storage time, the higher were acidity, proteolysis and bacteria counts. The standard plate, psychrotrophic and Pseudomonas spp counts increased from around 10^3, 10^3 and 10^2 ufc/ml (day 0) to 10^8, 10^7 and 10^6 ufc/ml (day 7), respectively. The lag phase was significantly longer for all analyzed microorganisms at shorter raw milk storage time and lower pasteurized milk storage temperature. The longer raw milk storage time and lower pasteurized milk storage temperature, the longer was its shelf life. The milk processed right after milking and stored at 5°C had 10.7 days of shelf-life while the milk processed after 7 days of raw milk storage and stored at 10°C had just 2.3 days of shelf-life. These results confirm the importance of having short raw milk storage time and low pasteurized milk storage temperature, besides good quality raw milk, to extend the pasteurized milk shelf-life and guarantee a safe product during this period.

Key Words: Shelf-Life, Pasteurized Milk, Raw Milk

W67 Colostrum fortified probiotic fat free yogurt. E. Albers[1], O. Cueva[1], and K. J. Aryana*[2], [1]*Louisiana State University*, *Baton Rouge*, [2]*Louisiana State University Agricultural Center*, *Baton Rouge*.

Colostrum is a good source of immune and growth factors. The probiotic bacterium *Lactobacillus acidophilus* offers several health benefits. Objective was to study the effect of colostrum on the physicochemical, microbiological and sensory characteristics of yogurt containing *Lactobacillus acidophilus*. Colostrum powder was added during yogurt mix preparation at 0, 4, 8 and 12 g per 228 g (8 oz) cup of yogurt. Colostrum incorporation in the manufacture of yogurt with *L. acidophilus* increased apparent viscosity, b^* (yellowness) values and decreased pH, syneresis, L^* (lightness) and a^* values. Colostrum incorporated at 4 or 8 g per 228 g yogurt increased lactobacilli counts over storage while use of colostrum at 12 g significantly decreased lactobacilli counts at 35 days of storage. Colostrum incorporated at 4 g per 228 g of yogurt improved the sensory characteristics namely, flavor, appearance and color, and body and texture of the yogurts. Colostrum incorporated at 12 g per 228 g of yogurt adversely affected product flavor and made the yogurts lumpy and too firm. It is perceived that the health benefits of colostrum can be added to probiotic yogurts by incorporation of colostrum at 4 g per 228 g of yogurt without adversely influencing product characteristics.

Key Words: Colostrum, Yogurt, Probiotic

W68 The effect of the ratio of ice cream mix to yogurt on the properties of the resulting yogurt ice creams. D. Olson*, K. J. Aryana, and C. Boeneke, *Louisiana State University Agricultural Center*, *Baton Rouge*.

The effect of varying the ratio of ice cream mix to whole milk yogurt on the characteristics of the resulting yogurt ice creams was investigated. Ratios of ice cream mix to yogurt included 0% ice cream mix and 100% yogurt (I) for the air-whipped and frozen yogurt control, 25% ice cream mix and 75% yogurt (II), 50% ice cream mix and 50% yogurt (III), 75% ice cream mix and 25% yogurt (IV), and 100% ice cream mix and 0% frozen yogurt (V) for the ice cream control. The resulting mixes were analyzed for total solids content, fat content, pH, and viscosity and frozen in a batch freezer. The frozen products were analyzed for sensory properties (flavor and body/texture), rate of meltdown of 100 g of frozen product at 21°C (volume after 1 h and time for 15 mL to melt), and MRS lactobacilli counts. The total solids contents were 11.7, 18.0, 26.4, 33.2, and 40.6%, and the fat contents were 3, 4, 7, 11, and 13% for I, II, III, IV, and V, respectively. The pH ranged from 4.54 for I to 6.73 for V. The I sample had the highest viscosity. The frozen products IV and V received the highest sensory scores, while I and II had the highest MRS lactobacilli counts. The rate of meltdown increased with increasing proportion of ice cream in the yogurt ice creams as no meltdown after 1 h was observed for I. Times needed to collect 15 mL of frozen product ranged from 40 min for V to 115 minutes for I. Yogurt ice cream made from IV had more desirable properties than yogurt ice cream made from II and III.

Key Words: Yogurt, Ice Cream, Yogurt-Ice Cream

W69 Characteristics of ice cream as influenced by a weight loss ingredient. K. J. Aryana*[1], D. Olson[1], and A. Greenbaum[2], [1]*Louisiana State University Agricultural Center*, *Baton Rouge*, [2]*Louisiana State University*, *Baton Rouge*.

Obesity is a health problem in the United States. A novel form of (-) hydroxycitric acid is being marketed as a weight loss ingredient (WLI). The objective was to study the effect of various amounts of the WLI on the physico-chemical, microbiological and sensory characteristics of ice cream. The WLI was incorporated into ice cream mixes at 0 (control), 1.5, 3.0 and 4.5 g per 473 mL of ice cream. Three replications were performed. Viscosity and pH were determined on ice cream mixes after one day of aging. Meltdown time for the first 15 mL, meltdown volume in one hour, bacterial counts, sensory flavor and body texture, heat shocked flavor and body texture were determined at weeks 2, 5, 9, 13 after product manufacture. The WLI decreased pH, increased viscosity of the ice cream mixes and increased meltdown volume of the ice creams. Use of WLI at 3.0 and 4.5 g resulted in faster meltdown and increased aerobic counts of the ice creams. The WLI did not influence flavor, body texture and heat shocked body texture of the ice creams. Use of WLI at 1.5 and 3.0 g resulted in the best heat shocked flavor. The WLI can successfully be used in ice cream manufacture.

Key Words: Obesity, Weight Loss, Ice Cream

W70 Influence of garlic on the characteristics of yogurt. K. Bridges[1] and K. J. Aryana*[2], [1]*Louisiana State University*, *Baton Rouge*, [2]*Louisiana State University Agricultural Center*, *Baton Rouge*.

Garlic has been researched for its ability to reduce cholesterol and triglycerides, prevent cancer, reduce blood pressure and hardening of the arteries and clotting and protect the liver. Garlic may also increase the effects of the immune system and reduce blood sugar levels. Objective was to study the influence of garlic on the microbiological physico-chemical, and sensory characteristics of yogurt. Powdered garlic was incorporated into the plain yogurts at 0, 0.5, 1 and 2 g per 8 oz of yogurt. Product manufacture was replicated three times. Garlic did not influence the lactic acid bacterial counts, the syneresis (released serum) and the pH of the yogurts. Garlic adversely influenced the flavor of the yogurts.

Key Words: Garlic, Spice, Yogurt

W71 Fatty acid composition of dairy foods and their intake in humans. T. R. Dhiman*, A. Hopkins, and N. Garg, *Utah State University*, *Logan*.

The objective of this study was to analyze dairy products and relate to fatty acid (FA) intake in humans. A total of 180 samples of dairy foods were collected from 43 different stores in selected 17 counties of Utah. Within the selected counties, cities, towns and stores were selected using random sampling tables. The samples included: 23 whole milk, 13 cream, 17 butter, 12 yoghurt, 13 sour cream, 12 cottage cheese, 14 cream cheese and 76 cheeses. Food samples were analyzed for FA profile, including conjugated linoleic acid (CLA). FA intake, g per serving was calculated. Fat, grams per 100 g of product and serving size data from USDA approved food labels and the USDA National Nutrient Database was used to calculate the FA intakes. Data was statistically analyzed as a two way factorial design. To simplify the presentation FA were grouped into saturated FA (SFA), *trans* FA, monounsaturated FA (MUFA), CLA, polyunsaturated FA (PUFA), n-6 FA, and n-3 FA. The proportion of SFA, in dairy foods (n=180) ranged from 63.9-66.3% of total FA, with fluid milk being lower than other dairy products. The proportions of total *trans* FA (C16:1 and C18:1) ranged from 4.52-5.31% of total FA. Cheese samples had lower total *trans* FA compared to other foods. The proportions of MUFA ranged from 24.7-26.1% of total FA, with fluid milk being higher than other dairy foods. The mean CLA content was 0.58 ± 0.05 % of total FA and did not differ among tested dairy foods. The proportions of PUFA, n-6 and n-3 FA ranged from 4.45-4.93, 3.19-3.80 and 0.51-0.64% of total FA in foods, respectively. The average intake of *trans* FA and MUFA was 0.4 and 0.5 g, 2.1 and 2.7g, from one serving of milk (240-ml) and cheese (28.35 g), respectively. Consuming one serving of whole milk or cheese provided 0.05 and 0.07 g of CLA, respectively. Assuming 69.25 g/d of fat intake in adult human with 5.2% as *trans* fat, our results suggest that one serving of whole milk contributes about 10% of total trans fat intake. Using the value 0.182 g of CLA intake/d in the United States from National Academy of Science report, consuming one serving of whole milk and cheese together will provide 66% of total daily CLA intake.

Key Words: Milk, Fatty Acid, Dairy

W72 High pressure processing prevents formation of overset eyes in Swiss cheese. N. Koca*[1,2], N. A. Kocaoglu-Vurma[2], V. M. Balasubramaniam[2], and W. J. Harper[2], [1]*Ege University*, *Bornova, Izmir, Turkey*, [2]*The Ohio State University*, *Columbus*.

Formation of overset eyes is a common problem encountered by Swiss cheese manufactures when lower than traditional cook temperatures (< 48°C) are used to produce Kosher whey. High pressure processing (HPP) can reduce the oversetting by eliminating nucleation sites and changing textural properties, provided that the starter cultures necessary for formation of characteristic eyes are not negatively affected by HPP. The objective of this study was to explore the effect of HPP on culture viability, eye formation, and textural characteristics of Swiss cheese. Swiss cheese was produced using 200 L pilot scale vats. The cheese blocks were divided into pieces (6x6x5 cm), brined, and vacuum packaged. Sample temperature was adjusted before pressure treatment to reach to 25±2°C during processing. Cheese samples were pressure treated at 50, 100, 200, 300, 400, 500 and 600 MPa over various pressure holding times (up to 15 min). Two sets of cheese samples held at refrigeration and room temperatures were used as controls. *Lactobacillus* spp., *Streptococcus thermophilus*, and *Propionibacterium* spp. were enumerated immediately after HPP and at the end of warm room ripening. Cheese samples were evaluated for eye formation at the end of warm room ripening. The texture profile and the pH of the samples were also determined. All pressure treatments with holding time of 5 min prevented the formation of overset eyes, 15 min treatments resulted in complete elimination of eye formation. The cheeses pressurized at 400 MPa for 5 min had excellent eye characteristics. Sample cohesiveness values increased until 400 MPa for the 5 min application whereas springiness values decreased until 300 MPa. Pressures above 300 MPa reduced the viable counts of *S. thermophilus* and *Lactobacillus* spp. whereas the propionibacteria counts remained unaffected. High pressure application has the potential to reduce overset eyes, and provides valuable information in understanding the relationship between texture of the cheese and oversetting.

Key Words: High Pressure Processing, Swiss Cheese, Eye Formation

W73 Effect of UHT and HTST processing on sweetness perception in sucrose–sweetened milk. J. M. Morton[1], S. J. Gualco*[2], P. Durongwong[2], J. Estrade[1], S. Vink[1], and P. S. Tong[1], [1]*Dairy Products Technology Center*, *San Luis Obispo, CA*, [2]*California Polytechnic State University*, *San Luis Obispo*.

Sensory analyses of milk have found Ultra High Temperature (UHT) processing to have a significantly different effect on the sensory properties of milk compared to High Temperature Short Time (HTST) processing. UHT processing of milk increases cooked and sulfur aromas and flavors as well as viscosity, which may suppress sweetness perception in UHT milks. We hypothesize that changes in these sensory modalities lead to a decrease in perceived sweetness, which would have significant ramifications for sucrose-sweetened flavored milks. Low fat (1% fat) milk was heat treated via either HTST (72.5°C for 15 seconds) pasteurization or indirect heat UHT (138.9°C for 3 seconds) process. Sucrose was added post-processing at levels of 1, 3, 5, 7, 9, and 11 percent by mass to produce 12 matched treatments plus 2 matched controls. Nine judges trained in descriptive analysis of sweetened milk evaluated the milks for appearance, aroma, taste, flavor, texture, and aftertaste. Judges individually evaluated each sample five times following a balanced block test design with a randomized, sequential monadic serving order. Although UHT and HTST milks differed significantly in aroma, flavor, and aftertaste ($p < 0.05$), ANOVA did not indicate a significant difference in sweetness intensity between matched UHT and HTST milks. However, Principle Components Analysis (PCA) of the milks revealed strong positive relationships between sucrose concentration and overall flavor, overall aftertaste, artificial sweetness, and sweetness intensity, with UHT milks showing a stronger relationship to these attributes than HTST milks. UHT milks were more strongly correlated with overall aroma, cooked aroma, opacity, viscosity, yellow color, and milky aftertaste than their HTST counterparts. These results suggest that sucrose-sweetened milks may be either UHT processed or HTST pasteurized without making adjustments to sucrose levels for equal sweetness intensity. Perceived sweetness appears to be more important for overall flavor and aftertaste in UHT processed milks.

Key Words: Sensory, Milk, Descriptive Analysis

W74 Gelation of β-lactoglobulin at low pH: Concentration effects. P. Mudgal*, C. R. Daubert, and E. A. Foegeding, *North Carolina State University*, *Raleigh*.

A modification procedure for whey proteins was patented by the Food Rheology laboratory at NC State University. This procedure imparts cold thickening functionality to whey proteins. Understanding the effect of protein concentration on thermal gelation and final functionality of the modified whey ingredient at low pH is the objective of the current study. Protein solutions of varying concentrations (c = 2-9 % w/w) were made from BioPure® β-lactoglobulin. Solutions were then pH adjusted to 3.35 with 6N HCl, followed by 3 hours of heating at 85°C. Following overnight incubation, specific viscosities of these solutions were determined at 25°C using a Cannon-Fenske capillary viscometer. From the results, intrinsic viscosity of heated β-lactoglobulin solutions was approximated to be 5 ml/g. The specific viscosity data was used to identify a critical concentration, reflecting a coil overlap concentration for biopolymer solutions. This concentration likely indicates the beginning of secondary interactions arising from the thermal treatment. To investigate the concentration effects on final functionality of a modified β-lactoglobulin ingredient, powders were prepared using two concentrations above (7, 9 % w/w) and two below (3, 5 % w/w) the critical concentration (6.9 % w/w). All powders were reconstituted in water at 10 % wt/wt and hydrated at 5°C for 24 hours. Shear rate sweeps were performed at 25°C to evaluate the thickening functionality. Significant differences were observed in apparent viscosities of solutions above and below critical concentration. Apparent viscosity at shear rate (˜10 s^{-1}) were found to be 3.28, 4.04, 31.9 and 3950 mPa-s for powders made from 3, 5, 7, and 9 % concentrations respectively. These results clearly show that preliminary protein concentration has significant effect on final ingredient functionality. Understanding these effects may be crucial to development of ingredients with improved functionality and provide insight into bio-molecular interactions during the gelation process of whey proteins at pH 3.35.

Key Words: Beta-Lactoglobulin, Gelation, Concentration

W75 Development of the hazard analysis and critical control points (haccp) in a milk pasteurizing plant. J. Aranda*, D. N. Garza, R. González, and L. A. Villarreal, *Universidad Autónoma de Nuevo León*, *San Nicolás de los Garza, México*.

The analysis of hazard and critical control points (HACCP) is a system dedicated to guarantee the harmlessness of the foods. The present work was carried out, in a milk pasteurizing plant with the purpose of evaluating the pre-requirements that should exist for the implementation of the HACCP. This evaluation was divided in three stages, in the first one it was carried out a diagnosis of the plant. This stage was focused on: the knowledge of the policies of the company, the existence of process manuals, the analysis of the production data, and quality of the product (according to NOM-091-SSA1-1994 NOM-184-SSA1-2000). It was registered 1053 data corresponding to the milk delivery for one year by the suppliers of the municipalities of Apodaca, Zuazua, Ramones, Santa Rosa, Dr. González, Salinas, Agualeguas and Marín. N. L., Mexico. In the second stage it was carried out an evaluation of the degree of fulfillment of the good manufacturing practices (GMP) and of standard operating procedures (SOPs). In the third stage it was developed a model of the system of analysis of hazards and critical control points, following the methodology of the HACCP. According to the results it was found that: the density, the percentage of water and the freezing point presented bigger deviation in most of the cases, as much in non-pasteurized milk as in the finished product, according to the NOM's indicated before. Regarding the degree of fulfillment of the GMP, the plant registered a percentage of fulfillment of 65.26%. Using the decision tree to identify the critical control points (CCP), the pasteurization stage was identified as CCP1 (it eliminates the hazard) and the storage and the transport as CCP2 (it controls the hazard).

Key Words: HACCP, Dairy, Quality

W76 Temporal global transcriptome analysis of *Lactobacillus acidophilus* during growth in milk. M. A. Azcarate-Peril* and T. R. Klaenhammer, *North Carolina State University*, *Raleigh*.

Microarray hybridization experiments were employed to monitor gene expression of *Lactobacillus acidophilus* NCFM cells propagated in 11% skim milk (SM) during early, mid and late logarithmic phase, and stationary phase. Approximately 21% of 1,864 ORFs were differentially expressed at least in one time point. Genes differentially expressed in SM included several members of the proteolytic enzyme system. Expression of *prt*P (proteinase precursor) and *prt*M (maturase) increased over time as well as several peptidases and transport systems. Expression of Opp1 (oligopeptide transport system 1) was highest at 4h, while gene expression of Opp2 increased over time reaching its highest at 12h. These results suggest that Opp1 and Opp2 have different specificities. Expression of LBA1525HPK-LBA1525RR, a previously characterized two-component regulatory system involved in acid resistance (Azcarate-Peril *et al.*, AEM, 71:5794), increased during early log and early stationary phase of growth. These results correlated well with survival experiments previously conducted that indicated that a chromosomally interrupted HPK mutant was more sensitive to acid challenge during early logarithmic phase of growth. To investigate the relationship between milk, growth and probiotic properties, *L. acidophilus*, 15 derivative strains, with mutations in genes identified in the microarray analysis as important for growth in milk, were selected for further analysis. Acidification rates were measured and correlated with the initial cell concentration in order to determine if any of the inactivated genes were involved in acidification activity and, hence, growth in milk in *L. acidophilus*. Five mutant strains with mutations in the surface layer protein *cdp*A, mucin-binding protein, putative myosin cross-reactive antigen, and a nicotinic acid mononucleotide adenylyltransferase *nad*D showed significantly ($P < 0.1$) different *tm* values than the parent control.

Key Words: Lactobacillus, Gene Expression

W77 Validation of Petrifilm plates for enumeration of total bacteria, psychotropic bacteria, and coliforms in goat milk. S. S. Chen[1,2], J. S. Van Kessel[3], B. Bah[1], F. Z. Ren[2], and S. S. Zeng*[1], [1]*Langston University*, *Langston, OK*, [2]*China Agricultural University*, *Beijing, China*, [3]*USDA-ARS*, *Beltsville, MD*.

Petrifilm™ Aerobic Count (AC) and Coliform Count (CC) plates were validated against standard methods for enumeration of coliforms, total bacteria, and psychrotrophic bacteria in raw (n = 39) and pasteurized goat milk (n = 17) samples. All microbiological data were transformed into log form and statistically analyzed using paired comparison t-test of SAS. There were no significant differences ($P < 0.01$) between Petrifilm™ CC and the standard Violet Red Bile Agar Petri dish method. Petrifilm™ AC was as accurate ($P > 0.05$) as the standard Petri dish methods for both total bacteria and psychrotrophic bacteria when the total bacteria count was less than $1x10^6$ CFU/ml. Correlations between Petrifilm™ plates and the standard Petri dish agar methods were high (r = 0.992, 0.997, and 0.974 for coliform, total bacteria, and psychrotrophic bacteria, respectively). In conclusion, Petrifilm™ AC and CC plates can be used as alternatives to standard methods for enumeration of total bacteria, psychrotrophic bacteria, and of coliforms, respectively. Advantages of Petrifilm™ plates include rapidity, ease of performance, labor saving, and no need for agar preparation or autoclaving. This validation is of practical importance to goat milk producers and processors because of the limited numbers of goat milk samples available daily and the lack of advanced laboratory facilities on most goat farms and in most goat milk processing plants.

Key Words: Goat Milk, Petrifilm Plates, Bacteria Count

W78 Applying slide-cover-glass method for cultivating anaerobic rumen fungi and employing polymerase chain reaction technique for their molecular identification. M. H. Sekhavati, M. R. Nassiry, M. Danesh Mesgaran*, and H. Tavasoli, *Ferdowsi University of Mashhad*, *Mashhad, Iran*.

The objective of the present study was to introduce a simple method (slide-cover-glass) for cultivating anaerobic rumen fungi and their molecular identification using PCR method. Rumen fluid, from a rumen fistulated sheep (live weight of 45 Kg) fed a 50:50 concentration:hay ration, was clarified by centrifugation at 10000 × g for 30 min and used as a source of inoculum. Then, 10 µ l inoculum was added to 290 µ l rumen fluid-agar medium (RFM) which were obtained in medium 10, containing antibiotic. This mixture was placed on a sterile slide on a warming table, covering it with a sterile cover glass, sealing their edges with paraffin, then incubated at 39°C for 3 days. After observing

the colonies on slides using an inverted microscope, in attempt to isolate specific fungi, colonies were picked and transferred into broth medium. DNA was extracted from pure culture medium by Guanidine Thiocyanate-Silica Gel method. Primers NS1 (5′GTAGTCATAT-GCTTGTCTC-3′) and NS2 (5′GGCTGCTGGCACCAGACTTGC-3′) were used to amplify a fragment from SSU 18S rDNA. In a volume of 20µl PCR reactions contained: 50 ng of template DNA, 2 µl 10-X PCR buffer , 2.5 mM MgCl2, 200 µM each dNTPs, 10 pM of each primer, and 1 U Taq DNA polymerase. Thermal conditions for 35 cycles were 95 °C (40 sec), 45 °C (40 sec), and 72 °C (1 min) . PCR products were visualized by electrophoresis on 1.3% agarose gel stained with etithium bromide. Microscopic studies on slide-cover-glass shows some anaerobes with filamentous colonies like fungi and the 550-bp fragment of nuclear-small-subunit (SSU; 18S rDNA) confirmed it. Since, Hungate roll tube technique for culturing and counting some anaerobes with vegetative growth is problematic, even impossible; therefore, it seems that this culturing method allows the handling of anaerobic rumen fungi in a more convenient approach.

Key Words: Slide-Cover-Glass, Anaerobic Rumen Fungi, PCR

W79 Quantification of *Staphylococcus aureus* which harboring sea in milk by real-time PCR. Y. Li* and Y. Jiang, *Key Lab of Dairy Science, Ministry of Education, Northeast Agricultural University*, *Harbin,China*.

Abstract: The presence of *Staphylococcus aureus* in milk, especially which produce enterotoxin A, is of major concern in the dairy industry. Staphylococcal enterotoxin A (SEA) is among the most potent of the growing list of known enterotoxins produced by *Staphylococcus aureus*, and a doses of less than µg of enterotoxins in contaminated food, which is produced by more than 105 CFU/g, will produce symptoms after 1-6 h in sensitive persons (FDA reported). In this study, we developed two real-time PCR assays, using either fluorophore-labeled DNA probes or DNA-binding dye SYBR Green, to identify the *Staphylococcus aureus* ATCC 13565 which harboring SEA genes. The detection procedure was applied to sterile milk samples artificially contaminated by *Staphylococcus aureus* ATCC 13565. And the assays we developed enable us to detect 83 CFU/ml in sterile milk. Both of the assays can be accomplished within 8 hours. The work really can offer a very quick, reliable alternative to identify the *Staphylococcus aureus*. And it would be offer great help to the further detection of *Staphylococcus aureus* which harboring sea genes in raw milk.

Key Words: Quantification, *Staphylococcus aureus*, Milk

W80 Detection of viable *Listeria monocytogenes* in milk by Real time RT-PCR. B. Yan* and Y. Jiang, *National Research Center of Dairy Engineering and Technology*, *Harbin, Heilongjiang, China*.

Detection of pathogens, such as *Listeria monocytogenes*, in contaminated food by PCR can result in false-positive data due to the amplification of DNA from nonviable cells. In this paper, a new method based on real-time reverse transcription PCR (RT-PCR) amplification of mRNA for the specific detection of viable was developed. Listeriolysin O (hlyA) gene was used as amplification targets. Total RNA from *Listeria monocytogenes* was isolated, and was amplified by real-time RT-PCR with a previously reported Taqman probe and primers specific for hlyA genes. The results show that this assay was positive for the *Listeria monocytogenes* standard strains and negative for all other strains such as *Staphylococcus aureus*, *Salmonella* and *Escherichia coli*. In pure culture, the sensitivity of detection Listeria monocytogenes is ca. 3×102 CFU/ml after enrichment 1-h, ca. 30 CFU/ml after enrichment 3-hrs. The feasibility of real-time RT-PCR amplification for the detection of viable *Listeria monocytogenes* was validated in artificially contaminated milk. Following a 6-hrs enrichment incubation *Listeria monocytogenes* could be detected that was originally inoculated in milk with ca. 17 CFU/ml. These results support the availability of real-time RT-PCR amplification of mRNA as a sensitive method for the specific detection of viable *Listeria monocytogenes* and indicate that this method may prove effective in the detection of this pathogen in milk products and other ready-to-eat.

Key Words: *Listeria monocytogenes*, Viable, Artificially Contaminated Milk

W81 PCR detection by rapid obtaining *Salmonella* in raw milk with filtration method. L. Wei and J. Yu-jun*, *National Research Center of Dairy Engineering and Technology*, *Harbin, Heilongjiang, China*.

A rapid, simple and sensitive PCR assay was developed for the determination of *Salmonella* in raw milk. Although many assays based on PCR for detecting food borne pathogen have been established, most of those techniques require 8~12h preenrichment step and thus are time consuming. This assay used filtration method to direct obtain bacteria in milk. Upon addition of disodium EDTA to skim milk which had been artificially contaminated by *Salmonellae*, casein micelles was dispersed to micromicelles and filtrated through 0.45 µm filter membrane. The Salmonellae in milk could been obtained from the membrane. It was then proceed with PCR to detect the bacteria which has been rapidly obtained by filtration method. The PCR system had been optimised to provide the best resolution of these analytes. The assay can be completed in 6.5h and reach 1~10 cfu/ml detection limit. To compare with other PCR assays, this assay without 8~12h preenrichment step saved a lot of time. The assay could be used for detecting *Salmonella* in raw milk and deserved to be generalize and applied to routine detection for food borne pathogen in raw milk.

Key Words: *Salmonella*, PCR, Filtration

W82 Acoustical emissions generated by *Lactococcus lactis* ssp *lactis* C2. C. L. Hicks*[1], J. M. Stencel[2], and H. Song[2], [1]*University of Kentucky*, *Lexington*, [2]*Tribo Flow Separations*, *Lexington, KY*.

Lactococcus lactis ssp *lactis* C2 bacteria in M17 medium and M17 agar was monitored (at 32°C for11 h) using contact acoustic sensors (20 to 50 kHz and 50 to 200 kHz) attached to the sides of the growth vessels. Acoustical emissions detected as waveforms, where each wave was referred to as a 'Hit' were generated by the bacteria . Hit sensitivity was in the µsec range. Fast Fourier transform analysis was used to calculate average peak frequencies of the emissions. Initial analysis showed that Hit detection began within 5 min after the medium was inoculated with *L. lactis* ssp *lactis* C2. Hits per min in

the agar medium increased from time of inoculation until the 9th h (beginning of the stationary phase) and then decreased until the 11th h. When C2 was grown in M17 broth and infected with c2 phage multiple periodic cycles of 36 min could be observed which appeared to match the phage lysis cycles. The average peak frequencies data showed a shift in frequencies as the bacteria moved from the lag into the log phase (from inoculation to 150 min). Some peak frequencies shifted by as much as 5 kHz during this growth period while most peaks had shifts in their relative intensities that increased or decreased with time. When average peak frequency data from C2 and *E. coli* 15q were compared (from the first 60 min of growth) only three of the peak frequencies were in alignment, while all other peak frequencies appeared to result from different acoustical emitting activities. These data suggest that average peak frequencies for C2 and *E. coli* 15q were sufficiently different in frequency and intensity during the initial lag phase that specific strain identification might be possible. Thus, acoustic emissions from bacteria may be specific enough to acoustically fingerprint bacteria and result in a rapid assay method.

Key Words: Acoustic, Lactococcus, Assays

W83 Survey of lactic acid bacteria in Hispanic-style cheeses for antimicrobial activity. J. A. Renye*, G. A. Somkuti, and D. L. Van Hekken, *Eastern Regional Research Center, USDA-ARS*, *Wyndmoor, PA*.

Lactic acid bacteria isolated from Hispanic-style cheeses were screened for antimicrobial activity against dairy starter bacteria (*Lactococcus lactis* and *Streptococcus thermophilus*) and potential foodborne pathogens or spoilage organisms (*Listeri*a, *Escherichia, Staphylococcus*, *Shigella*, *Salmonella*, *Enterobacter* and *Pseudomonas*). The LAB species screened included *S. thermophilus* (8), *S. macedonicus* (7), *L. lactis* (4), *Leuconostoc mesenteroides* (13), *Lactobacillus plantarum* (8), *Enterococcus faecium* (14), and *Enterococcus faecalis* (11). The LAB isolates were grown overnight in M17 (streptococci) or MRS (lactobacilli and leuconostocs) medium and tested for antimicrobial activity by the agar-well diffusion method. One *S. thermophilus* isolate showed activity against both *S. thermophilus* and *L. lactis* target strains, while another inhibited *L. lactis* only. The *L. lactis* target strain was also inhibited by one *L. lactis* and one *E. faecium* isolate. All 8 *L. plantarum* isolates inhibited the growth of *P. fluorescens*. Four of the isolates were also inhibitory to *E. coli* and *S. epidermidis*, while 2 other isolates inhibited only *E. coli*. All 6 of *L. mesenteroides* strains showed activity against *P. fluorescens*. The 3 *E. faecium* isolates active against *Listeria monocytogenes* were further screened by PCR for genes encoding known bacteriocins. Two of the isolates were shown to have PCR products corresponding to enterocins A, P and L50B. The third *E. faecium* isolate did not test positive for any of the known enterocins (A, B, P, BC25, L50A, L50B and Q), suggesting the possibility of a novel antimicrobial peptide. None of the isolates screened showed activity against *S. sonnei*, *S. infantis* and *E. sakazakii*. Further biochemical characterization of the antimicrobial compounds produced by the LAB is in progress.

Key Words: Antimicrobial, Bacteriocin, Lactic Acid Bacteria

W84 Production of bacteriocins by staphylococcal strains isolated from Brazilian cheese. M. A. V. P. Brito[1] and G. A. Somkuti*[2], [1]*EMBPRAPA Dairy Cattle Research Center*, *Juiz de Fora, Brazil*, [2]*Eastern Regional Research Center, USDA-ARS*, *Wyndmoor, PA*.

A total of 285 staphylococcus isolates were recovered from *Minas frescal* cheese, a traditional Brazilian fresh cheese made with pasteurized milk, and screened for the production of antibacterial substances. The staphylococci were isolated from 50 lots of commercial cheese and cultured on mannitol salt agar. Isolates were evaluated for colony and cell characteristics, catalase production and further classified as coagulase-positive (169) or coagulase-negative (116) by the tube coagulase test. Bacteriocin activity of cell-free supernatants of overnight cultures was tested by the agar-well diffusion method with *Listeria monocytogenes* Scott, *L. ivanovii*, *Staphylococcus aureus* 305 and *Streptococcus agalactiae* 5778 as targets. Bacteriocin production was associated with 30 coagulase-positive staphylococci (10%), including activity against *L. monocytogenes* (24), *S. aureus* 305 (26), *L. ivanovii* (13) and *S. agalactiae* (3). Plasmid samples isolated from bacteriocin-producing isolates were checked with PCR techniques using primers specific to the staphylococcal bacteriocins aureocin A70 and A53, and staphylococcin BacR1. All 24 isolates with antilisterial activity yielded PCR products and positive Southern blots indicating the presence of the aureocin A70 structural gene but only 20 of the 24 isolates carried the 8-kb plasmid that is usually associated with aureocin production. The 5 additional isolates active against *S. aureus* 305 only and tested negative with BacR1 primers may be producers of novel bacteriocins. The results have shown that antilisterial cheese isolates of *S. aureus* produced plasmid borne aureocin A70 similar to strains often recovered from bovine milk. The presence of bacteriocin activity may increase the competitiveness of the producing strain and may also have a role in preventing contamination by *L. monocytogenes*.

Key Words: Bacteriocin, Staphylococcus, Cheese

W85 Inhibitory effect of *Lactobacillus* species on *Streptococcus mutans in vitro*. W. Y. Yang[1], A. R. Hostetler[1], C. S. Huh[2], and H. S. Kim*[1], [1]*Culture Systems, Inc.*, *Mishawaka, IN*, [2]*Korea yakult Co.*, *Yongin Si, Kyunggi Do, Korea*.

S. mutans has been recognized as an important etiological agent in human dental caries. It has been suggested that these cariogenic bacteria could be eliminated from dental plaque by application of *Lactobacillus* or bacteriocin-like inhibitory substances. Recent clinical and experimental observations showed that specific probiotic microorganisms may provide therapeutic benefits in human dental disease. However, few data exist on the ability of *Lactobacilli* to inhibit the growth of *S. mutans*. The purpose of this study was to isolate and characterize *Lactobacilli* that inhibit the growth of *S. mutans* and to test the possibility that probiotic *Lactobacillus* strains are able to reduce dental caries. Four *Lactobacillus* species, *Lactobacillus fermentum* CS6039, *Lactobacillus reuteri* CS6032, *Lactobacillus acidophilus* CS6051, *Lactobacillus fermentum* CS332, were isolated from volunteers classified as having good oral hygiene and breast feeding mothers. The inhibition of *S. mutans* treated with probiotics was monitored by agar plate assay, competition test, and a turbidity and inhibition method. Using the agar plate assay and competition test, the diameters of the clearance zones surrounding the inoculated bacteria (which indicated the presence of bacteriocin produced by probiotic cultures) were measured. All tested-lactic acid bacteria were able to

inhibit the growth of *S. mutans in vitro*, with *L. fermentum* CS6039 exhibiting the highest inhibition. The turbidity and inhibition method was also performed to confirm the results from agar plate assay and competition test. All of the probiotic cultures, except *L. reuteri* CS332, significantly inhibited growth of *S. mutans* ($P<0.05$). Based on these data, we suggest that lactic acid bacteria have a beneficial impact on inhibition of S. mutans and preventing dental caries.

Key Words: *Lactobacillus*, *Streptococcus Mutans*, Inhibition

W86 Lipid binding characterization of lactic acid bacteria in dairy products. D. Bachiero*, S. Uson III, and R. Jimenez-Flores, *California Polytechnic State University*, *San Luis Obispo*.

Probiotic bacteria are defined as a supplement that provides well being to the consumer when they are live and active. These microorganisms have gained more attention because of their known health benefits such as gastrointestinal health, enhancement of the immune system and their ability to inhibit pathogenic bacteria. However, there is still disagreement in defining their mechanisms of activity as well as methods of assessing them. An important limitation is the lack of knowledge regarding the nature in which these bacteria interact and bind in the gut as well as in the dairy system. Many studies have focused on the protein binding properties while the binding to lipids has been poorly studied. We focused on developing an assay that gives a quantitative measurement of lactic acid bacteria's (LAB) affinity to bind to various lipids found in dairy foods. LAB strains used in this study were genetically characterized, isolated and typed using pulse field electrophoresis. Cells were used in their exponential phase of growth for the experiments. An immunobloting technique was used as a quantitative measurement of bacteria's binding to various lipids from milk or buttermilk. Extracted lipids were separated on a TLC silica membrane, blotted on to PDF membranes and then exposed to biotinylated bacteria, to observe binding affinity. The bacteria/lipid interaction was measured using Avidin-HRP and Diaminobenzidine for a visual color reaction. We found two types of lipid binding: non-specific binding to triglycerides (non-polar lipids), in which the lipid concentration was the significant variable, and strain specific binding to phospholipids (polar lipids), where regardless of composition, each strain showed specific binding affinity. More importantly, these results show the specificity of binding as the direct result of the degree of processing of the dairy product. Those powders undergoing supercritical fluid extraction showed an increase in binding to phospholipids. These results will help in the design and formulation of dairy foods containing probiotic strains thus optimizing the bacteria's beneficial effects on health.

Key Words: Lactic Acid Bacteria, Binding, Lipids

Egg and Meat Science and Muscle Biology - Livestock and Poultry III

W87 Growth of muscular and adipose tissues of young heifers from different genetic groups. E. Rodrigues, M. D. B. Arrigoni, A. M. Jorge, P. S. A. Moreira, W. Bianchini, J. C. Hadlich, C. Andrighetto, C. L. Martins, D. D. Millen*, and R. D. L. Pacheco, *FMVZ/UNESP–Botucatu*, *São Paulo, Brazil*.

The objective of this study was to evaluate the growth of young heifers from different genetic groups (GG) in an intensive meat production system. It was used 42 animals of 4 different GG: 12 3/4 Canchim × 1/4 Nellore (3/4 CN), 12 1/2 Canchim × 1/2 Nellore (1/2 CN), 10 Crossbreed where the Simmental had predominance (SI) and 10 Three way cross – 1/4 Simmental × 1/4 Nellore × 1/2 Angus (TC). The Canchim breed is composed by 5/8 Charolais and 3/8 Nellore (Zebu breed). The experiment was conducted at the experimental feedlot of the Veterinary Medicine and Animal Science College, São Paulo State University, Botucatu campus (UNESP), Brazil. The animals received creep feeding supplementation and were weaned at 210 days of age with 247.4 ±16.48kg. It was analyzed the body weight characteristics, average daily gain (ADG), muscular and fat tissues growth. Real time ultrasound evaluation was used to measure rib eye area (REA, Longissimus dorsi muscle), back fat thickness (BFT) and P8 (Top rump, Biceps femoris) fat thickness. The animals were fed for 132 (±14) days in feedlot system with a high concentrate diet. ADG was measured every 28 days. The heifers were slaughtered when the final weight of 350 kg and 5mm of back fat thickness predicts were reached. TC heifers had smaller ($P<0.05$) final (TC=61.6, 3/4 CN=69.4, 1/2 CN=66.2, SI= 65.2) and adjusted at 100 kg/BW (TC=15.2, 3/4 CN=17.8, 1/2 CN=17.7, SI=18.9) rib eye area (cm^2) compared to the others GG. This group also had a greater ($P<0.05$) final body weight in kilos (TC=405, 3/4 CN=390, 1/2 CN=374, SI=350), better ADG ($P<0.01$) in kilos/day (TC=1.07, 3/4 CN=1.04, 1/2 CN=0.95, SI=0.94) and an intermediate days of feeding. There was not significant differences for initial REA, BFT and P8, but when the values were adjusted for fewer days of feeding (114 days), greater values ($P<0.01$) were found for TC and SI for P8 114 (TC=8.8, 3/4 CN=6.5, 1/2 CN=5.7, SI=8.4) and for SI for REA 114 (TC=55.7, 3/4 CN=55.3, 1/2 CN=52.7, SI=65.2). Thus, heifers TC performed better than other GG tested showing a grain adaptation as zebu percentage in GG composition got lower.

Key Words: Rib Eye Area, Back Fat Thickness, Ultrasound

W88 Evaluation of performance, tissue growth and meat tenderness of Nellore, Brangus and Canchim young bulls. R. B. Rodrigues, M. D. B. Arrigoni, E. Rodrigues, D. D. Millen, R. D. L. Pacheco*, H. N. Oliveira, C. C. Laurino, M. V. Fossa, L. M. N. Sarti, M. Parrili, S. A. Matsuhara, C. L. Martins, J. P. S. T. Bastos, and T. M. Mariani, *FMVZ/UNESP–Botucatu*, *São Paulo, Brazil*.

This study had the objective to compare three different genetic groups with different zebu percentage in their compositions: Nellore (N), Brangus – 5/8 Red Angus, 3/8 Nellore (BC) and Canchim – 5/8 Charolais, 3/8 Nellore (CC). It was used 87 animals (27 CC, 30 N and 30 BC) separated by genetic groups and randomly disposed. The weaning weight in kilos was 244.6, 243.6 and 295.0 for N, BC and CC respectively with 8 months old, which were supposed to be slaughtered with 15 months of age around 450 to 500kg in a commercial packing plant. The experiment was conducted at the experimental feedlot of the Veterinary Medicine and Animal Science College, São Paulo State University, Botucatu campus (UNESP), Brazil. The feeding period

was 158 days including 28 days of adaptation using a high concentrate diet. The dry matter intake (DMI) was measured every day, subtracting the waste from the amount fed. Average daily gain (ADG) and feed efficiency (FE) were obtained every 28 days, weighting the animals after 16 hours withheld the feed. Simultaneously, real time carcass ultrasound was used to measure Longissimus dorsi area (LEA) and subcutaneous fat thickness (SFT). For carcass evaluation, samples of LEA between twelfth and thirteenth ribs were collected from the left carcass to evaluate tenderness by shear force method (SF). DMI and FE did not differ (P>0.05) among the genetic groups tested. ADG in kilos/day differed (P<0.05) from CC to the other two groups (CC=1.46, BC=1.22 and N=1.14). LEA differed in cm^2 (P<0.05) for all treatments (CC=86.92, BC= 77.01 and N=71.14). SFT in millimeters showed difference (P<0.05) in all treatments (CC=3.91, BC=6.67 and N=5.15). According to SF in kilograms force the CC group presented significant difference (P<0.05) when compared to the other two groups (CC=3.98, BC=2.75 and N=2.74). The results indicated that CC had a better ADG, a faster and longer muscular growth than BC and N, but had the worst fat deposition and SF in this experiment; what may be explained for the major frame size of the animals used to compose this GG: the Charolais.

Key Words: Performance, Tissue Growth, Shear Force

W89 Efficacy of blood hemoglobin as an indicator of pork quality. A. N. Lepper*, H. N. Zerby, S. J. Moeller, K. M. Brueggemeier, and A. C. Naber, *The Ohio State University*, *Columbus*.

The objective of the study was to assess the efficacy of pre-harvest blood hemoglobin level as a predictor of pork quality in market weight swine. Market weight swine (n = 110) were harvested over three dates, following a 12 h rest in a commercial packing. Each harvest group consisted of proportional numbers of purebred Berkshire, Landrace and the reciprocal crossbred pigs. Blood hemoglobin (HB, Hemocue Hb 201) content was obtained from a sample collected 24 h prior to harvest via the anterior vena cava. Carcass backfat (BF), loin muscle area (LMA) and loin quality traits, including Minolta L* and a*, visual color (C), marbling (MARB), firmness (F), wetness (W), and pH were measured at 24 h post-harvest. Warner-Bratzler Shear (WBS) force assessment of the loin was completed on a chop aged for 7 d post-harvest. Data were analyzed using multi-trait analysis of variance for dependent carcass and pork quality measures. Fixed effects included breed combination and sex with a random harvest date effect. Residual correlations were estimated after accounting for model effects to determine associations among traits and simple correlations were estimated. After adjusting for breed, gender and harvest date effects BH was only associated (P < 0.05) with WBS (r = 0.23). Significant simple correlations were observed between HB and WBS (r = 0.22, P < 0.05) and pH (r = -0.28, P < 0.01) with the simple correlation between Minolta a* (r = 0.17, P < 0.06) approaching significance. The results indicate blood hemoglobin level, collected prior to harvest was not a good indicator of subsequent pork quality and would not be an effective tool for selection of live pigs as breeding animals to improve pork quality.

Key Words: Pork, Quality, Hemoglobin

W90 Evaluation of Haugh Units and yolk index as criteria to establish a low temperature storage limit for refrigerated shell eggs. D. Shin*[1], C. Narciso-Gaytan[1], M. Sartor[1], J. R. Regenstein[2], and M. X. Sánchez-Plata[1], [1]*Texas A&M University*, *College Station*, [2]*Cornell University*, *Ithaca, NY*.

More than 89.9 billion eggs are distributed yearly in the U.S., most of them as table eggs transported and stored under refrigerated conditions. The USDA recommends the storage of shell eggs at temperatures below 7.2°C (45°F) for food safety reasons. However, no lower temperature storage limit has been recommended. Recent industry reports indicate that storage of shell eggs at low temperatures -close to 0°C (32°F) - may be associated with quality deterioration effects such as "running whites" and "flaccid yolks". The goal of this study was to establish a low temperature storage limit for shell eggs based on the effect of low temperatures in conventional egg quality parameters including Haugh units, yolk index, albumen pH, yolk pH, vitelline membrane strength and cake density during prolonged storage. Fresh shell eggs, at least six per measurement for each of three replications, were stored under controlled refrigerated conditions at -1.1, 0.6, 2.2, 3.9, 5.6 and 7.2°C. Samples were taken at days 0, 2, 7, 14, 21 and 28. As expected, Haugh units decreased while albumen pH increased during storage at all temperatures. Significant Haugh unit differences (*P<0.05*) were observed in eggs after 14 days of storage. High storage temperatures caused a faster decline in Haugh units and yolk indexes when compared to the lower temperatures evaluated. However, after 28 days of storage differences were more evident, indicating higher quality preservation at temperatures below 2.2°C. Results indicate that a low temperature storage limit for shell eggs could be established between 0.6 and 2.2°C, especially if eggs were to be stored beyond two weeks under these conditions.

Key Words: Shell Eggs, Storage Temperature, Haugh Units

W91 The acceptance of brown-shelled eggs in a white-shelled egg market. N. P. Johnston*[1], L. K. Jefferies[1], B. Rodriguez[2], and D. E. Johnston[1], [1]*Brigham Young University*, *Provo, UT*, [2]*University of San Andres*, *La Paz, Bolivia*.

In recent years brown-shelled (BS) eggs have gradually entered the traditional white-shelled (WS) egg markets as a distinctive mode for packaging specialty eggs. A test was conducted at the Brigham Young University Sensory Laboratory to gain an understanding of how consumers view various attributes of the BS egg relative to the WS egg. The objectives were two fold, first to see how the consumer viewed properties of eggs by color and secondly the preference for brown color intensity. It was hypothesized that consumers would view BS eggs as more nutritious and more likely laid cage-free. It was further hypothesized that the darker colored BS eggs would be preferred to lighter ones. To test the hypothesis 52 panelists, all women who routinely purchased and consumed eggs, completed the evaluation. Of the panelists 46.2% consumed eggs daily and the remainder (53.8%) at least twice weekly. Frequency of egg purchases were weekly (9.6%), every two weeks (30.8%), and every three to four weeks (48%). 26.9% purchased specialty eggs (omega-3, organic or cage free). The panelists preferred WS eggs (90.4%), but as hypothesized BS eggs were viewed as likely more nutritious, flavorful,

fresher, higher in omega-3, and originating from a "farm flock" fed only organic ingredients. To test the preference for shade of BS eggs, a set six eggs with varying intensities of brown color was evaluated for appearance using a 9 point hedonic scale. The egg color intensities were measured using a Hunter Colorflex Spectrophotometer and the CIEL* system. The L* values ranged from 83.2 for WS eggs to 63.6 to 46.5 for the BS eggs. Contrary to our hypothesis there was a significant (P<0.05) preference for the lighter shades of brown (L* 63.6 and 53.3). Using the same scale panelists then compared BS to WS eggs. Again the two most lightly tinted BS eggs were found most comparable WS eggs in acceptability and better (P0<.05) than the darker colored BS eggs. In conclusion WS eggs were preferred over brown eggs but BS eggs were viewed as likely more nutritious, flavorful and fresher, and laid in a non-caged setting. Panelists preferred the appearance of the lightly tinted to darker BS eggs.

Key Words: Eggs, Color, Preference

W92 Nutritional composition of raw and fried enhanced or non-enhanced boneless chicken breast fillets. J. Kiker*[1], J. Howe[2], J. Holden[2], J. Boyce[1], A. Luna[1], C. Alvarado[1], D. Wester[1], and L. Thompson[1], [1]*Texas Tech University*, *Lubbock*, [2]*Beltsville Human Nutrition Research Center*, *Beltsville, MD*.

Research was conducted to determine the nutritional value of enhanced (E) and non-enhanced (NE), raw or battered and breaded (BB) fried boneless chicken breast fillets. Two trials were conducted in which 65 fillets per trial were E by injection with a 0.6% NaCl/0.4% Na triphosphate solution, and 65 fillets were not E. Injected fillets retained 9.2% solution based on the raw NE weights. After equilibration at 4°C for 48 h, half of the fillets from each treatment were BB using an automatic system, and then fried in a commercial fryer to an endpoint temperature of 74°C. ANOVA and means separation by LSMeans were conducted using GLM procedures in SAS. Percentage moisture was similar in raw fillets (75.8%, P > 0.05), while raw fillets were higher in moisture than cooked (E-fried 55.31% and NE-fried 52.15%, P < 0.0001). Cooking concentrated ash (E-fried 2.33% vs E-raw 1.89%, P < 0.0001; NE-fried 1.36% vs NE-raw 1.03%, P < 0.0001). Means for percentage protein were greater in NE than in E fillets (NE 21.7% vs E 19.0%, P < 0.03). Fat content was higher in E-fried (6.6%) compared to NE-fried fillets (4.7%, P < 0.0001). Phosphorus and sodium contents were significantly higher in E than NE-fillets (252 mg P/100 g, 586 mg Na/100 g vs. 200 mg P/100 g, 296 mg Na/100 g, respectively, P < 0.0001). A 100-g serving of NE-fried breast fillet would provide 43.4% of the daily reference value (DRV) for protein, 7.2% of the DRV for fat, 12.3% of the DRV for Na, and 20.0% of the reference daily intake (RDI) for P. In contrast, a 100-g serving of E-fried fillet would provide 38%, 10.2 % and 24.4% of the RDV for protein, fat and sodium, and 25.2% of the RDI for P. Enhancement increased moisture content in the cooked product by 6.1%, Na by 98.0%, and P by 26.0%.

Key Words: Chicken Breast Fillets, Composition, Enhancement

W93 Physical and chemical meat traits of young heifers from different genetic groups. E. Rodrigues, M. D. B. Arrigoni, A. M. Jorge, P. S. A. Moreira, W. Bianchini, D. D. Millen, R. D. L. Pacheco*, J. C. Hadlich, C. Andrighetto, and C. L. Martins, *FMVZ/UNESP–Botucatu*, *São Paulo, Brazil*.

The objective of this study was evaluate physical (marbling, tenderness, evaporation losses (EL), leak losses (LL) and total losses in the cooking (TLC)) and chemical (Humidity, crude protein and lipids) meat traits from different genetics groups of young heifers finished in feedlot. Marbling was determined by a subjective score (1–5). The animals were divided in four groups: 12 3/4 Canchim × 1/4 Nellore (3/4 CN), 12 1/2 Canchim × 1/2 Nellore (1/2 CN), 10 Crossbreed where the Simmental had predominance (SI) and 10 Three way cross – 1/4 Simmental × 1/4 Nellore × 1/2 Angus (TC). The Canchim breed is composed by 5/8 Charolais and 3/8 Nellore. The experiment was conducted at the experimental feedlot of the Veterinary Medicine and Animal Science College, São Paulo State University, Botucatu campus (UNESP), Brazil. The SI animals had higher (P<0.01) marbling scores (TC=2.3, 3/4 CN=2.0, 1/2 CN=2.0, SI=2.5) when compared to 3/4 CN and 1/2 CN. For tenderness, measured by shear force in kilograms force, there was no significant difference (P>0.05) after seven days of ageing with the meat samples at zero Celsius degree (TC=2.1, 3/4 CN=2.0, 1/2 CN=2.1, SI=1.8). Regarding EL, LL and TLC, in percentage, the 1/2 CN was better (P<0.05) than others groups tested (EL: TC=11.8, 3/4 CN=12.9, 1/2 CN=7.5, SI=12.6; LL: TC=2.7, 3/4 CN=3.2, 1/2 CN=1.5, SI=3.3; TLC: TC=14.6, 3/4 CN=16.1, 1/2 CN=9.0, SI=15.9). There were no significant differences (P>0.05) among the genetic groups evaluated regarding chemical analysis, observing the mean values of 74.86%, 22.15% and 1.39% for humidity, crude protein and lipids, respectively. The 1/2 CN presented less losses when compared to the other groups tested. The meat of young heifers finished in feedlot is ideal for the packing plants and consumers requirements in Brazil.

Key Words: Meat, Heifers, Feedlot

W94 Evaluation of meat tenderness of forage-finished cattle produced in Hawaii and factors affecting the tenderness. Y. S. Kim*, A. Ong, N. Bobbili, M. DuPonte, G. K. Fukumoto, and C. N. Lee, *University of Hawaii, Manoa*, *Honolulu*.

The objective of this study was to evaluate the current status of meat tenderness of forage-finished cattle produced in Hawaii and to determine what production factors affect the meat tenderness of forage-finished cattle. Two ribeye steak samples from the 12th rib were obtained from 191 forage-finished cattle sacrificed at two local slaughter houses on Hawaii Island. The steak samples were vacuum-packaged in Kapak pouches individually and aged for 2 wk at 4°C, then were stored at -20°C for later proximate analysis and measurement of shear force values of cooked steaks. The vacuum-packaged steak samples were thawed and cooked in a water bath at 70°C for 1 h, cooled to room temperature, and shear force values were measured from 1.3 cm core samples (6 per steak). Information on animal age, breed, carcass weight and sex was obtained during sample collection from the slaughter houses. Carcass weight ranged from 353 lb to 939 lb with a mean value of 601.8 lb. Intramuscular fat content ranged from 0.19% to 14.11% with a mean value of 4.49%. Shear force value ranged from 2.41 kg to 9.41 kg with a mean value of 5.21 kg. The shear force value of heifers (5.52±0.133 kg) was higher (p<0.05) than that of steers (4.96±0.148 kg). The shear force value of the age group between 24-36 months (4.97±0.137 kg) was lower (P<0.05) that that of the age group over 36 months (5.51±0.149 kg) or the age group below 24 months (5.23±0.321 kg). The shear force value of Hereford breed (n=19, 6.24±0.288 kg) was higher (P<0.05) than that of Angus (n=53, 5.19±0.172 kg), or Bos taurus crosses (n=76, 5.06±0.144 kg),

or other breeds (n=25, 4.91±0.251 kg). Correlation coefficient of shear force value with intramuscular fat was 0.025, indicating that the intramuscular fat is not a good indicator for meat tenderness of forage-finished beef. In conclusion, the results of this study indicate that meat tenderness of forage-finished cattle can be improved by proper selection of breed types and slaughter age.

Key Words: Forage-Finished Beef, Meat Tenderness

W95 The effect of dietary mushroom supplementation on egg characteristics and production attributes of leghorn hens. W. L. Willis, O. Isikhuemhen, A. Ely, D. Coverington, and C. King*, *North Carolina Agricultural and Technical State University*, *Greensboro*.

An experiment was conducted to assess the effect of Shitake (Lentinus edeods) mushroom powder on laying hens' performance and their egg characteristics. Sixteen 45 wk old Single Comb White Leghorn hens were divided into control and experimental treatment groups, replicated four times with two hens per replicate cage group. The experimental hens were fed a 20% mushroom powder supplemented ration and the control received a standard laying ration for a period of one month. Body weights and egg components were weighed for each treatment group. Total fat (as triglycerides) saturated fat (as fatty acids), transfat (as fatty acid) and the percentage saturated, monounsaturated, polyunsaturated and unknown fat were determined in eggs from treatments. The hens fed the supplemented mushroom powder diet had a higher average body weight loss, whereas, the control fed hen exhibited a higher average weight gain. Egg production was not significantly affected by diet. The feeding of 20% mushroom powder for this short duration, however, resulted in higher numerical values for egg whites and yolks (63.4 vs 62.7 and 36.2 vs 34.9), respectively. There was no significant ($p<0.05$) differences in saturated, monounsaturated, polyunsaturated and unknown fats between the two treatments. There was a trend for higher total fat, saturated (as fatty acids), and transfat in the mushroom supplemented hen eggs. Although the effects of dietary mushroom were not statistically significant with respect to fats and egg components, the results indicate that the use of an appropriate level of powder or extract in laying hen diets will change the parameters studied.

Key Words: Laying Hens, Mushroom, Saturated Fats

W96 On the tenderness of commercial boneless skinless broiler breast meat. Y. S. Lee*, C. M. Owens, and J. F. Meullenet, *University of Arkansas*, *Fayetteville*.

Although broiler processing practices have been fairly uniform across the industry, this is changing with the advent of specialty poultry processors. For example, immersion chilling has been the standard in industry but recent product introductions have included air chilling. Furthermore, although the enhancement of broiler breast meat is still common, non-enhanced and natural products have been introduced to satisfy market demand. The objective was to assess the level of tenderness of commercial products representing various industry practices. Six commercial boneless skinless breast meat products representing 4 brands were purchased at local supermarkets on four occasions over a period of 3 months. Two products followed an air chill process with no enhancement and carcass aging durations of ~ 24 hrs. Two of the water chilled products were enhanced with up to 15% of a solution containing chicken broth while the other two contained up to 3% of water retained. Aging duration for the water chilled products was thought to follow standard practices (4-6 hrs). All products were cooked covered to an internal temperature of 71°C in a convection oven. Tenderness was instrumentally measured by the Meullenet-Owens-Razor-Shear (MORS) using a TA-XT2 plus Texture Analyzer (Texture Technologies Corp., Scarsdale, NY). Cooking loss was also calculated. Both air chilled and one enhanced products were found to be most tender with MORS energy values corresponding to moderately tender meat. The two water-chilled but non-enhanced products corresponded in average to tenderness levels considered by consumers as slightly tough. Cooking loss of the two air chilled products (13.5-15.5%, respectively) were significantly lower than that of water chilled products (18.7-22.6%). Results showed an array of tenderness in commercial products with several products showing unacceptable tenderness. Sensory analysis and consumer acceptance of such products should be further assessed to determine if tenderness is a key driver of acceptance and if other characteristics are also important to liking.

Key Words: Tenderness, Broiler Breast Fillet, Chilling

W97 Feeding wet distillers grains plus solubles reduces shelf life and increases lipid oxidation during retail display of beef steaks. A. S. de Mello Junior*, B. E. Jenschke, C. R. Calkins, L. M. Grimes, J. M. Hodgen, and G. E. Erickson, *University of Nebraska*, *Lincoln*.

Strip loins (*M. Longissimus lumborum*), tenderloins (*M. Psoas major*) and top blades (*M. Infraspinatus*) from 46 carcasses of calf-fed, crossbred steers, were evaluated to test the effect of wet distillers grains plus solubles (**WDGS**) in beef cattle finishing diets on beef shelf-life (color and oxidation). The animals were randomized into three groups (0%, 15% or 30% WDGS – DM basis) and fed for 133 d. After grading, the short loins (IMPS # 174) and shoulder clods (IMPS # 114) were vacuum-packaged and shipped to the University of Nebraska Meat Laboratory. At 7 d postmortem, two steaks were cut from each strip loin, tenderloin and top blade. One steak was vacuum packaged and frozen (-16°C) immediately until a measurement of rancidity could be made (thiobarbituric acid reactive substances - TBA). The other steak was divided in two and the halves were wrapped in oxygen-permeable film and displayed for 3 and 7 days under simulated retail conditions (200-250 ft-candles light, 2°C). For the top blade and strip steaks, inclusion of 30% WDGS in the diet resulted in higher levels of oxidation (higher TBA values) in the lean after 7 d display (Top blade: 3.84^{a}, 5.04^{a}, 8.42^{b} for 0, 15 and 30% WDGS, respectively; $P < 0.001$. Strip steaks: 2.02^{a}, 3.77^{b}, 4.81^{b}, respectively; $P = 0.001$). There were no effects of WDGS on TBA values of tenderloin steaks ($P = 0.191$). After 3 d of retail display, steaks from cattle fed WDGS were numerically higher in TBA values than those from controls ($P = 0.075$ for top blades and 0.285 for strips). Top blade steaks from cattle fed 15 or 30% WDGS were darker (lower L^* values) than controls ($P < 0.028$). Top blade and tenderloin steaks from cattle fed 30% WDGS were significantly less red (lower a^* values) after 3 d of retail display ($P < 0.040$). These data indicate that feeding WDGS can compromise the shelf-life of steaks.

Key Words: Distillers Grains, Oxidation, Shelf-Life

W98 Mapping tenderness of the *M. Serratus ventralis*. L. M. Grimes* and C. R. Calkins, *University of Nebraska*, *Lincoln*.

To map the tenderness of beef *M. Serratus ventralis* (**SV**) muscles and evaluate the effectiveness of an enhancement strategy, beef chucks (n = 32), with the brisket and shoulder clod removed, were obtained from both sides of 8 USDA Choice and 8 USDA Select-grade beef carcasses two days post mortem. At 7 d postmortem, SV from one side were enhanced (**E**) with a 12.5% solution containing beef broth, salt, phosphate, and rosemary extract; and alternate sides were the control (**C**). Both C and E muscles were blade tenderized once as a whole muscle and cut into halves by a medial cut from dorsal to ventral, splitting the muscles into anterior and posterior halves. The halves were cut into steaks beginning at the dorsal edge, creating 4 to 8 steaks per half. All steaks of the E muscles were then blade tenderized again. Steaks were vacuum packaged and frozen. Every other steak from each SV was thawed overnight, cooked to an internal temperature of 70°C, cored, and sheared to obtain Warner-Bratzler shear force values (**WBS**). Cores were taken approximately every 2.54 cm from anterior to posterior throughout the steak. Regardless of grade, E samples produced significantly lower WBS values ($P < .001$) than C samples, decreasing WBS from 3.85 kg to 2.99 kg, a reduction of 22%. For USDA Select muscles, the most ventral steak was least tender ($P < .001$) and the most anterior location within the steak was the toughest. For USDA Choice samples, differences occurred from anterior to posterior, not dorsal to ventral ($P > 0.050$). All WBS means from the posterior side of Choice-grade SV muscles were numerically lower than the anterior side. Tenderness varies throughout the SV, and enhancement techniques can decrease WBS values. Across both grades, the least tender areas were those toward the anterior portion of the carcass. It appears that steaks could be cut from the posterior portion of the SV, as WBS values were in the acceptable range.

Key Words: Enhancement, Serratus Ventralis, Tenderness Mapping

W99 Correlations among carcass, meat and eating quality traits of finishing pigs. C. C. Tsai*[1], L. L. Lo[1], Y. C. Yang[1], R. S. Lin[2], T. H. Huang[3], J. Chen[1], L. C. Lee[1], P. Y. Lo[1], and H. J. Chien[1], [1]*Chinese Culture University*, *Taipei, Taiwan, ROC*, [2]*National ILan University*, *ILan,Taiwan ROC*, [3]*Taiwan Farm Industry Co., Ltd.*, *Pingtung, Taiwan, ROC*.

To establish the relationships among meat and eating quality, carcass and meat quality data were analyzed from 120 Duroc and Landrace (DL) crossbred pigs. Pigs were raised under commercial farm condition, and were transported to a commercial slaughter plant when reached the slaughter weight to collect the carcass performance data. Sections of Longissimus muscle (LM) from 9th to last rib were removed and transported to Chinese Culture University for meat quality evaluations. Carcass traits included the 10th rib backfat thickness, LM area (LMA), and the subjective scores of color, firmness, and marbling and the meat quality traits included were color, pH, shear force value, water holding capacity, chemical analysis and sensory evaluation. Backfat at the 10th rib was significantly correlated with drip loss (-0.37), water holding capacity (0.20), ash (0.21) and intramuscular fat content (0.50). The saleable lean weight was also correlated with water holding capacity (0.38) water (-0.42), and protein (0.364). Higher ultimate LM pH was associated with lower L value (-0.69), lower b value (-0.61), more water, less ash, less protein, and more intramuscular fat content ($P<0.05$). Marbling score was significantly associated with intramuscular fat content (0.53), and Hunter L value was correlated with color score (-0.28). Eating quality of juiciness, tenderness, and flavour scores were significantly correlated with ultimate pH, drip loss and water holding capacity. These results indicate that many factors might influence the eating quality of pork, and the correlation information may provide some knowledge to DL producers to improve their pork′s competitiveness.

Key Words: Carcass Performance, Meat Quality, Pigs

W100 A novel laser air puff and shape profile method for predicting tenderness of broiler breast meat. Y. S. Lee*, A Saha, C. M. Owens, and J. F. Meullenet, *University of Arkansas*, *Fayetteville*.

The laser air puff with shape profiles is a novel non-destructive method for predicting poultry meat tenderness from the raw state. It has the advantages of being non-contact and non-destructive and could be implemented in an on-line setting for classifying tough and tender meat at line speeds. The objective was to examine the potential application of this new system to assess poultry meat tenderness. Ninety broilers were deboned at either 1.75, 4 or 24 h postmortem (PM). The raw breast fillets were first scanned on a conveyor belt longitudinally by a laser distance sensor to obtain overall shape profiles and scanned again with a pressurized source of air (30 psi). The profile created with air was overlapped over the original profile to examine differences between the two profiles. Five parameters including height and length of each fillet were calculated and used to establish a model to predict tenderness. Instrumental and sensory analysis on cooked meats was conducted by the Meullenet-Owens-Razor-Shear (MORS) and seven trained panelists, respectively. Hardness and MORS Energy (MORSE) were modeled with the parameters extracted from the air puff system. Both models were highly significant ($P<0.0001$). Predicted values obtained from the models and observed values of individual fillets were subjected to Logistic regression to classify tender and tough meat. Tender fillets, in the predicted tender group, represented 75% and 81% based on hardness and MORSE, respectively. This represents a 20% improvement in the number of tender fillets after classification. Of the parameters used for the prediction, those measuring the amount of deformation due to the pressurized air were negatively correlated to tenderness, indicating that tender cooked meat sustains more deformation by pressurized air in its raw form. The results suggested that this new system could potentially be implemented as an on-line tool for sorting poultry breast fillets by tenderness levels.

Key Words: Air Puff, Broiler Breast Fillet, Tenderness

W101 Effect of morphological traits on intake characteristics of four grass species found in temperate biodiverse pasture systems. K. J. Soder* and M. A. Sanderson, *USDA-ARS, Pasture Systems & Watershed Mgmt. Research Unit*, *University Park, PA*.

Meadow fescue (MF, *Festuca elatior*), orchard grass (ORG, *Dactylis glomerata*, L.), quack grass (QG, *Elytrigia repens*), and reed canarygrass (RCG, *Phalaris arundinacea*) were sown in micro-sward boxes (79 cm × 47 cm × 11.5 cm) to investigate intake characteristics of four grass species. Once established, micro-swards were defoliated at 21-d intervals before being offered to non-pregnant, non-lactating Holstein cows in short-term tests. Boxes were weighed (± 0.1 g) before and after each test during which cows were allowed to take approximately 50 bites. Bite mass, DM content, sward surface height, tiller length and density, and leaf width, length and area data were collected. Mean DM bite mass was greatest for QG and RCG. Sward surface height was greatest for RCG and lowest for MF. Tiller length was greatest for ORG. Tiller density was greatest for MF and QG. Leaf width was greatest for ORG and RCG. Leaf length was greatest for ORG and lowest for QG and RCG. Leaf area was greatest for ORG and RCG. Sward surface height was the best predictor of DM bite mass, which may lead to greater apparancy of that species, thus the grazing animal may consume more material from that species, potentially subjecting that species to greater grazing selection than others in the same sward. However, implications on long-term survival of that species would be dependent on residual and sward re-growth characteristics after repeated defoliation.

Table 1.

	MF	ORG	QG	RCG	SE
Forage DM, %	21.9	21.4	28.0	26.5	3.05
Bite mass					
....g fresh/bite	3.89^{ac}	4.29^{b}	3.48^{a}	4.02^{bc}	0.15
.... g DM/bite	0.85^{a}	0.90^{ab}	0.97^{bc}	1.07^{c}	0.05
Sward surface height, cm	20.84^{a}	26.33^{b}	24.09^{ab}	31.74^{c}	1.16
Tiller length, cm	27.67^{a}	36.20^{b}	24.02^{a}	27.38^{a}	1.12
Tiller density, cm^2	97.31^{a}	72.45^{b}	107.83^{a}	75.40^{b}	3.83
Leaf width, cm	2.78^{a}	2.97^{b}	2.76^{a}	2.98^{b}	0.05
Leaf length, cm	14.52^{a}	17.63^{b}	10.70^{c}	10.57^{c}	0.86
Leaf area, cm^2	43.83^{a}	136.76^{b}	55.02^{a}	101.66^{b}	9.81

^{abc} Means within the same row with different superscripts differ ($P < 0.05$).

Key Words: Biodiverse Pasture Systems, Grazing Behavior, Intake Characteristics

W102 Estimation of forage intake and the presence of alkaloids in ruminal fluid and forage in steers grazing three different fescue types. R. L. Stewart, Jr*, G. Scaglia, J. P. Fontenot, W. S. Swecker, Jr., A. O. Abaye, J. H. Fike, and M. A. McCann, *Virginia Polytechnic Institute and State University*, *Blacksburg*.

During two consecutive grazing seasons, DMI of steers grazing 'Kentucky-31' endophyte infected (E+), endophyte free (E-), and Q4508-AR542 non-ergot alkaloid-producing endophyte infected (Q) tall fescues (*Festuca arundinacea*) was estimated. Also, ergovaline (EV) and lysergic acid amide (LSA) were quantified in forage and ruminal fluid of steers grazing E+. Estimates of DMI did not differ ($P = 0.88$) when based on samples collected at 0800, 1700, or a composite of the two sampling times. Estimation of DMI using handplucked samples tended to be higher ($P = 0.06$) than from whole plant clipped samples. In 2004, estimated DMI of steers grazing E- was higher ($P < 0.001$) than Q and E+. In 2005, DMI of steers grazing E- was higher than Q and E+ in June ($P < 0.05$), and higher ($P < 0.05$) for steers grazing E- than Q in September. Lysergic acid amide, an analog of lysergic acid, and EV were present in E+ forage throughout the grazing season but were not detectable in E- and Q. Similarly, LSA appeared in ruminal fluid of steers grazing E+, but not in steers grazing E- and Q. Ergovaline was not detectable in ruminal fluid of steers grazing any of the three fescue types. The appearance of LSA in ruminal fluid through the season was similar to patterns of forage alkaloids (LSA and EV). Lower DMI may affect performance of steers grazing of E+. Low DMI of steers grazing Q suggests that the fescue variety Q4508 may not be the optimal variety for the incorporation of non-ergot alkaloid-producing endophyte strains. Additionally, the appearance of LSA in ruminal fluid of steers grazing E+ suggests that this ergot alkaloid may contribute to fescue toxicosis.

Key Words: Dry Matter Intake, Ergot Alkaloids, *Festuca arundinacea*

W103 Efficacy of EndoFighter™ for stocker cattle grazing endophyte-infected tall fescue pastures during late summer and fall. R. Norman[1], C. D. Lane[1], S. S. Block[2], W. W. Gill[1], A. E. Fisher[1], R. L. Mills[1], B. T. Campbell[1], F. N. Schrick[1], and J. C. Waller*[1], [1]*University of Tennessee, Knoxville*, [2]*ADM Animal Nutrition Research*, *Decatur, IL*.

An 84 d grazing trial was conducted (Aug 24–Nov 17) near Spring Hill, TN was to determine the efficacy of EndoFighter™, an ADM Alliance Nutrition, Inc. product designed to be fed to cattle grazing or fed endophyte-infected fescue. Jesup tall fescue pastures grazed in this trial were > 90% infested with *Neotyphodium coenophialum* (E+). Sixty weaned crossbred heifers (325 kg) were used in a randomized block design, blocked by weight, breed and previous treatment and randomly allotted to pastures with four animals per 1.2-ha paddocks and five replications per treatment. Treatments were ADM Alliance Nutrition, Inc mineral products: 1) Mastergain® mineral = Control; 2) EndoFighter™ mineral; 3) Prototype mineral. Heifers had free choice access to E+ grass, water and shade. Heifers were weighed on d 0, 1, 28, 56, 83, and 84. Initial and final weights were an average of the two beginning and ending weights, respectively. Data collected were initial, d 28, d 56, and final weights, and ADG (period 1 = d 1 to 28; period 2 = d 29 to 56; period 3 = d 57 to 84; total = d 1 to 84). Blood serum was collected at d 0, 28, 56, and 84 for prolactin analysis. Mineral consumption and animal grazing behavior were determined at 14-d intervals. Data were analyzed using the MIXED procedure of SAS. For all variables, contrasts were performed to compare Control to mineral supplements containing EndoFighter™ or Prototype. Total ADG (kg) and average daily mineral consumption (g) were: 0.61, 170*; 0.56, 122*; 0.50, 146; for Control, EndoFighter™ and Prototype, respectively (*$P < .09$). Serum prolactin was not different ($P > .05$) among treatments. According to National Weather Service data for

Franklin, TN, the maximum temperature reached at least 32.2° C on four days of the trial. Animal performance and prolactin levels were not significantly affected by the feeding of EndoFighter™ or Prototype in this trial. Mild weather conditions may have contributed to the lack of responses observed because heifers were not stressed by a combination of E+ and elevated ambient temperature.

Key Words: Beef Heifers, Tall Fescue, EndoFighter™

W104 Effect of cultivar and defoliation frequency on forage yield of *Chloris gayana* kunth in a moderate saline soil of the semiarid chaco of Argentina. M. V. Cornacchione*[1], H. E. Pérez[2], and A. E. Fumagalli[1,3], [1]*Instituto Nacional de Tecnología Agropecuaria*, *Santiago del Estero, Argentina*, [2]*Instituto Nacional de Tecnología Agropecuaria*, *Leales, Tucumán, Argentina*, [3]*Universidad Nacional de Santiago del Estero*, *Santiago del Estero, Argentina*.

The aim of the trial was to evaluate the effect of four cultivars and clipping frecuency on forage production, leaf:stem ratio, dead leaf proportion anf leaf protein content of *Chloris gayana* in a moderate saline soil (from 0 to 60 cm depth, the avg. ECe=9.6 dS/m and avg. pH=7.95). The experimental design was a completely randomized block in a split-plot arrangement with four replicates. The main plot had three tetraploid and one diploid cultivar; Callide, Boma, INTA-PEMAN (Experimental line; EL), and Topcut respectively. The grasses were sown in February of 2005. The split-plot consisted of two defoliation treatments (beginning November 2005 to May 2006): every seven weeks clipping (SWD) and the other at the end of the growing season (mature forage defoliation, MFD). Cultivar × defoliation interaction was not statistically significant for all variables, except for the % of dead leaf (P<0.01). Cultivars did not differ in forage yield, but forage production was greater in MFD (9850±1580 kg DM/ha; P<0.01) than SWD (6380±1048 kg DM/ha). Leaf:stem ratio was similar among cultivars, but did differ (P<0.01) in response to defoliation treatment (3.67±0.80 vs. 0.63±0.10 for SWD and MFD respectively). Under SWD Topcut and Callide had less % of dead leaf (P<0.01; 4.29±0.76 and 4.45±0.83 respectively) than Boma and EL (6.95±1.36 and 7.86±1.6), but in MFD % of dead leaf was significantly different among cultivars (P<0.01). Thus Callide, EL, and Boma had approximately 34, 64, and 75% more dead leaf than Topcut (on average 70.19±1.35, 86.05±1.12, 91.72±1.74 and 52.32±9.69). Leaf CP was significantly greater in SWD vs. MFD (P<0.01; 7.51±0.50 vs. 3.74±0.86 for SWD vs. MFD). EL, Boma and Topcut were similar in leaf CP (6.1±1.74, 6.05±2.18 and 5.50±2.64, respectively) and Callide was lower (4.83±2.24; P<0.01). In conclusion the seven weeks defoliation frequency decreased forage yield, however this frecuency consistently improved forage quality and reduced the proportion of dead leaf. Among cultivars Topcut was superior due to less proportion of dead leaf.

Key Words: *Chloris gayana*, Forage Production, Saline Soil

W105 Effect of herbage depletion on cattle grazing dynamics in wheat pastures. P. Gregorini*[1], M. Bowman[3], W. Coblentz[4], P. A. Beck[2], and S. A. Gunter[2], [1]*USDA–ARS*, *University Park, PA*, [2]*University of Arkansas SWREC*, *Hope*, [3]*University of Arkansas*, *Fayetteville*, [4]*USDA–ARS*, *Madison, WI.*

Two complementary experiments were conducted to assess grazing dynamics, intake rate, quality and ruminal degradation kinetics of herbage consumed under three herbage depletion levels. In the first experiment (behavioral), three rumen cannulated steers faced (15 min. grazing session) grazing scenarios simulating the levels of pasture depletion at three sward surface heights (ungrazed, 21 cm, CNTL; medium, 14 cm, MD; and high depletion level, 7 cm, HD). Grazing scenarios were sampled for green leaf and stem mass. Intake rate was determined by rumen evacuations. Grazing dynamic was determined by bite/min, bite depth, eating step/min, eating distance, potential area harvested while grazing, and bites and intake/feeding station. Also, quality of potential herbage eaten was estimated by herbage hand-plucking. In the second experiment (ruminal degradation kinetics) samples of herbage eaten by steers during the grazing sessions of the first experiment were incubated in situ in five rumen fistulated steers. The soluble, degradable and undegradable consumed herbage DM fractions were determined, as well as the DM disappearance rate, lag time and DM effective degradability. Green leaf and stem mass quadratically concave decreased (P = 0.01) from CNTL to HD. Treatment did not affect herbage DMI (675 g, SE = 45; P = 0.14) during the grazing sessions; but tended (P = 0.06) to decrease herbage DMI/ feeding station with increasing depletion level. Depletion led steers to a quadratically convex increase in eating steps/ min, eating distance and potential area harvested while grazing (P < 0.05). Depletion did not affect bite rate (33 bites/min SE = 6; P = 0.10); but led to shallower bites (P < 0.01). None of the herbage potentially consumed and ruminal degradation kinetics parameters were affected by treatment (P > 0.05). Under these experimental conditions, steers adapted grazing dynamics to sustain a constant nutrient intake. Behavioral adaptations would make nutrient intake rate less sensitive to certain herbage depletion levels.

Key Words: Grazing Behavior, Herbage and Nutrient Intake, Ruminal Degradation Kinetics

W106 Evaluation of ryegrass-based pastures grazed under the leaf stage concept in commercial dairy farms in the highlands of Costa Rica. J. M. Sánchez*[1,2], L. Villalobos[1,3], and A. Martínez[1,2], [1]*Universidad de Costa Rica*, *San José*, [2]*Centro de Investigación en Nutrición Animal*, *San José, Costa Rica*, [3]*Escuela de Zootecnia*, *San José, Costa Rica*.

Perennial ryegrass (Lolium perenne) grows year round in the highlands of Costa Rica (2700 to 3200 m in altitude) and does not require annual reseedings as it often does in temperate climates, due to the lack of frost in this tropical region. These characteristics as well as its high DM yield and good nutritional value makes this pasture a good alternative for dairy farmers in the area. Because of the irregular topography and the diversity of microclimates in the highlands of Costa Rica, dairy farmers have had to apply plant phenological concepts such as leaf stage, to determine when to graze this pasture. The aim of this study was to analyze the yield, utilization of the pasture on offer and botanical composition of ryegrass-based pastures, and nutritional value according to NRC (2001) proposed methodologies, in four farms located between 2700 and 3200 m in altitude in the Central Mountains of Costa Rica. Farms were selected at random and pastures were grazed at 32 to 45 d intervals. Measurements and samples were taken every two months during a year period. Results show cows in the four farms grazed ryegrass at a proper vegetative stage, since the average number of leaves found before defoliation was 2.85, and this grass is

considered a 3 leaf plant. Likewise, botanical composition analysis shows that 75.9% of the biomass was ryegrass, 13.9 other grasses, 6.1 clover, 1.3 weeds and 2.8 senescent material. Average DM yield was 18 t/ha/year, which is similar to those obtained in temperate climates under ideal conditions of environment and management. Pastures in the four evaluated farms were established more than 15 years ago. On average, pasture contained 25.2% CP, 49.8% NDF, 25.6% ADF, 15.4% NFC, 3.3% Lignin and 1.53 Mcal/ kg NEL (3X), all on DM basis. Agronomic and nutritional data shows the grazing system based on the leaf stage concept is a good tool for managing ryegrass-based pastures in areas where topographic and climate conditions are diverse.

Table 1.

Farm Nº	Nº of leaves at grazing	Regrowth period, d	DM yield, kg/ha/cut	% of grass on offer utilized	CP DM%	NL_L (3X) Mcal/kg DM
1[1]	2.87[a]	45	3787	45.2	24.7[b]	1.55[a,b]
2	2.88[a]	35	4510	48.4	22.9[c]	1.48[b]
3	2.81[a,b]	35	4187	43.2	26.5[a]	1.47[b]
4	2.78[b]	32	3839	41.3	26.8[a]	1.62[a]

[a,b,c]Means in a column with different superscripts are different (P≤0.05)
[1]Average of 12 samples or measurements

Key Words: Ryegrass, Plant Phenology, Nutritional Value

W107 Supplementation of digestible fiber and glucomannan to tall fescue pastures: Dry matter intake and fecal alkaloid concentration. R. L. Mills*[1,2], C. J. Richards[2], and J. C. Waller[1], [1]*The University of Tennessee*, *Knoxville*, [2]*Oklahoma State University*, *Stillwater*.

An 84 d randomized block design utilizing 96 weaned beef calves (238.8 ± 20.1 kg) in each of two consecutive years was used to assess the efficacy of digestible fiber and glucomannan (MTB-100®, Alltech, Nicholasville, KY) supplementation. Groups of four test calves were randomly assigned to 24 endophyte-infected tall fescue (*Lolium arundinaceum* Schreb. S.J. Darbyshire) spring pastures (1.23 ± 0.06 ha) with additional grazer calves used in a put-and-take system. Pastures, blocked by previous productivity, were randomly assigned to one of five treatments: 1) no supplementation (CON); 2) supplemented with soybean hulls (SH) at 0.33% BW (DM basis; LO); 3) supplemented with SH at 0.66% BW (DM basis; HI); 4) LO plus 20 g/d MTB-100®; and 5) HI plus 20 g/d MTB-100®. Calves had free-choice access to water and a loose vitamin/mineral mix. Chromic oxide was dosed and fecal grab samples obtained (d 54 to d 59) to estimate fecal output and fecal alkaloid concentration determination. Total DMI was calculated using IVDMD and fecal output. Data were analyzed using the MIXED procedure in SAS with contrasts of main effects of SH level (LO vs. HI), MTB, SH level x MTB, and CON vs. supplemented (SUPP). No interaction between SH level and MTB was observed ($P > 0.10$). Supplementation increased forage DMI and total DMI ($P < 0.01$) by 3.0 and 4.3 kg/d above the control with HI SH tending to increase total DMI by 8.9% over the LO SH level ($P = 0.06$). Fecal ergot alkaloid concentration decreased ($P < 0.01$) 31.3% with supplementation and was not affected by MTB ($P > 0.05$). Increasing from LO to HI SH tended to decrease fecal alkaloid concentration 11.2% ($P = 0.08$). These results indicate that digestible fiber supplementation can increase total intake and reduce fecal alkaloid concentration of calves grazing endophyte infected tall fescue pastures, but addition of glucomannan had no influence.

Key Words: Tall Fescue, Soybean Hulls, Glucomannan

W108 Evaluation of endomycorrhizal colonization in three species of crassulacean acid metabolism in northern part of Mexico. J. R. Martinez*[1], M. A. Peña[2], R. E. Vazquez[1], E. Gutierrez[1], E. Olivares[1], J. A. Vidales[1], and R. D. Valdez[3], [1]*Facultad de Agronomia, UANL*, *Monterrey, Mexico*, [2]*INIFAP*, *General Teran, Mexico*, [3]*CRUCeN, Universidad de Chapingo*, *Zacatecas, Mexico*.

An experiment was conducted (from April to October of 2006) to evaluate the mycorrhizal colonization in the radical volume of agave (Agave americana), spineless prickly pear (Opuntia sp.), and native prickly pear (Opuntia lindheimeri). This project was carry out because these plants have been less studied than C3 species as enhancers of degraded areas, as well as their forage value in semidesert zones. Mycorrhizal colonization can help to survive this species when they are transplanted into eroded soil by improving water and nutrient transport. This work was analyzed using a 3×2 factorial arrangement of treatments including three species: agave, spineless prickly pear and native prickly pear, inoculated with 100 spores and not inoculated, using three pots by treatment. Fungus used for the inoculation was Glomus intraradices. Mycorrhizal colonization and count of spores were evaluated, and mycorrhizal colonization was transformed to Arcsen. Both variables were greater ($P<0.05$) for native prickly pear and agave than spineless prickly pear. Mycorrhizal colonization was 73.8, 71.9 and 60.6% for agave, native prickly pear and spineless prickly pear, respectively. Spore count was greater ($P<0.05$) for agave and native prickly pear than spineless prickly pear. Spore count were 10,000, 9,150 and 4,400 spores per 100 g of dry ground for agave, native prickly and spineless respectively. It was possible to colonize roots of agave and prickly pear by inoculating with spores of Glomus intraradices.

Key Words: Mycorrhiza, Prickly Pear, Agave

W109 Evaluation of EndoFighter™ in a tall fescue grazing system for beef cattle. A. E. Fisher*[1], S. S. Block[2], K. J. Daniels[2], M. A. Franklin[2], N. A. Pyatt[2], and J. C. Waller[1], [1]*University of Tennessee, Knoxville*, [2]*ADM Animal Nutrition Research*, *Decatur, IL*.

The objective of this project was to evaluate EndoFighter™ mineral fed to stocker cattle grazing endophyte-infected tall fescue (*Festuca arundinacea*) pasture during summer grazing conditions. EndoFighter™ mineral was supplied by ADM Alliance Nutrition, Inc. and is recommended for use when beef cattle are grazing endophyte-infected tall fescue. The study was conducted near Dandridge, TN from April through September 2006, using 125 beef steers (avg initial wt = 274 kg) in a 126-d grazing period. Three groups were placed at Location 1 and two groups at Location 2, which were less than one mile apart. At both locations, steers were allotted to one of two treatments: Control (n=53, ADM Alliance Nutrition, Inc. MasterGain® mineral CTC/IGR) and Treatment (n=67, MasterGain® with EndoFighter™ CTC/IGR).

Mineral mixtures were formulated for consumption of 0.11 kg/h/d. Cattle grazed tall fescue-dominated pasture and were supplemented with corn gluten feed pellets at 1.36 kg/h/d. Forage samples were collected for Ergovaline analysis. Individual animal weights were recorded on d 1, 63 and 126 and behaviors were recorded twice per week at 1300 for the duration of the trial. Recorded behaviors were grazing (shade or no shade), lying (shade or no shade) and at water. The maximum temperature reached at least 29.4° C on 72 days of the trial. Five steers were removed from experiment due to morbidity. All data were analyzed using the MIXED procedure of SAS with individual as the experimental unit for growth, hair coat and body condition. Differences were determined at $P < 0.05$. Treatment cattle had a higher average daily gain than Control cattle (0.80 vs. 0.69 kg/h/d, respectively, $P < 0.01$). Cattle behavior was affected by treatment with more Treatment cattle observed grazing than control (761 vs. 200 occurrences, respectively, $P < 0.01$) and more Control cattle located in shade than Treatment (1394 vs. 1413 occurrences, respectively, $P < 0.01$). Offering a mineral product containing EndoFighter™ resulted in better gains and more grazing behavior by cattle grazing tall fescue pasture during the summer.

Key Words: Beef Cattle, Tall Fescue, EndoFighter™

W110 Changes in chemical composition and vertical distribution of kura clover-reed canarygrass swards relative to days of regrowth. K. L. Kammes*, D. K. Combs, and K. A. Albrecht, *University of Wisconsin*, *Madison*.

Knowledge of the plant-animal interface is essential to better understand intake, ingestive behavior, and diet selection of grazing dairy cows. Four 0.75 ha pastures with a mixture of 45% kura clover (*Trifolium ambiguum* Bieb.) and 55% reed canarygrass (*Phalaris arundinacea* L.) were used in a randomized complete block design to evaluate changes in chemical composition and vertical distribution of swards in relation to days of regrowth across periods, cuts, species, and layers. Samples were taken from four separate plots at nine time points throughout the trial which consisted of three periods (June 5-19, July 5-19, and July 24-August 7) with three regrowth ages in each period. Days of regrowth at the start of each period were 17, 26, and 31, respectively, followed by two subsequent samplings with 7 days between each sampling within a period. Pastures were mechanically harvested once before period 1 and twice before periods 2 and 3. Herbage samples were cut at ground level and bundled together to maintain the vertical structure of the sward. Each sample was divided into either reed canarygrass (RCG) or kura clover (KC) and then cut into 10-cm layers starting from the base of the plant. The layers were analyzed for neutral detergent fiber (NDF) and crude protein (CP). The NDF concentration ranged from 23 to 35% and 56 to 67% of DM for KC and RCG, respectively, with the highest concentration in the lower layers that contain mainly petioles and stems. Concentration of CP ranged from 17 to 31% and 11 to 24% of DM for KC and RCG, respectively, being highest in the upper strata that primarily consist of leaves and leaf blades. When the sward was analyzed as a whole; there was a single linear relationship between NDF (slope = 0.44) and CP (slope = -0.25) and days of regrowth, regardless of period or cut. By knowing the chemical composition of the vertical distribution and the depth of grazing, it is possible to predict the chemical composition of herbage selected by ruminants.

Key Words: Pasture, Intake, Dairy

W111 Growth performance and immune function of fall-born beef calves weaned from endophyte infected tall fescue pastures on different dates in the dpring. J. D. Caldwell*[1], K. P. Coffey[1], W. K. Coblentz[1], R. K. Ogden[1], M. L. Looper[2], D. L. Kreider[1], J. A. Jennings[2], D. S. Hubbell, III[1], T. W. Hess[1], and C. F. Rosenkrans, Jr.[1], [1]*University of Arkansas*, *Fayetteville*, [2]*USDA-ARS*, *Marshfield, WI*.

Fall-born calves grazing *Neotyphodium coenophialum*-infected tall fescue [*Lolium arundinaceum* (Schreb.) Darbysh.] (E+) should benefit from early weaning because of reduced exposure to E+ toxins, but our previous research has not supported this hypothesis. Gelbvieh × Angus calves (n=238) were used in a 3-yr study to determine the optimal time to wean fall-born calves grazing E+ pastures. Cow-calf pairs were allocated randomly by weight and age to one of four weaning dates: 1) March 13 (177 d of age; MrW), 2) April 13 (204 d of age; ApW), 3) May 11 (236 d of age; MyW), and 4) June 8 (264 d of age; JuW). At weaning, calves were weighed, vaccinated, blood collected, and calves were moved to a 3.2-ha pasture adjacent to their dams. After 14 d, blood samples were collected a second time, and calves were weighed and moved directly to wheat (MrW and ApW) or bermudagrass (MyW and JuW) pastures. Calf BW did not differ ($P>0.21$) among treatments on the earlier weaning dates, but BW on the June weaning date, actual and 205-d adjusted weaning BW, ending BW (14 d following the June weaning date), and BW change between the March and June weaning dates increased linearly ($P<0.05$) across treatments. Response to bovine virus diarrhea and infectious bovine rhinotracheitis vaccination measured 14-d post-weaning increased ($P<0.05$) linearly, and that of bovine respiratory syncytial virus increased ($P<0.05$) linearly and quadratically across treatments. Total antioxidant potential at weaning and change during weaning increased ($P<0.05$) linearly across treatments. Predominantly linear trends were observed ($P<0.05$) across treatments for various serum minerals and red and white blood cell counts. Delaying the weaning of fall-born calves grazing E+ pastures until early June may be beneficial for calf growth and immune function.

Key Words: Calves, Fescue, Weaning Date

W112 Intensive short duration grazing of fescue pastures to extend the grazing season of winter wheat. W. A. Phillips*, B. K. Northup, and B. C. Venuto, *USDA-ARS Grazinglands Research Laboratory*, *El Reno, OK*.

Over 10 million ha of winter wheat (*Triticum aestivum* L.) are planted in the southern Great Plains (SGP) each year, and serves as the major forage resource for millions of stocker calves before they enter the feedlot for finishing. If more BW gain is produced during the stocker phase, then the amount of feed grains used during the finishing phase will be less. This experiment examined the feasibility of using a perennial cool-season grass to extend the period of grazing for winter wheat and produce more kg of BW/calf. Three, 1.7-ha 2-yr old tall fescue (*Festuca arundinarea* Var. Jessup ″Max-Q™) pastures were used for short periods of intensive grazing in the spring (S) and fall (F). The pastures were fertilized each year with 56 kg of N/ha (F and S) and 22 kg of P/ha (F only). Calves (n= 215; 280 ±32 kg BW) used were predominately British breeds, less than 12 months of age. A different set of calves were used in each grazing period (3 S and 3 F periods). Standing crop available for grazing at the start of the grazing period was used to determine the stocking rate. Data were analyzed using a mixed model to determine the impact of grazing period on

stocker performance with pasture serving as the experimental unit and year (n=3) was random. Pastures produced more (P < 0.01) forage in the S than in the F (4490 vs. 2230 kg DM/ha) and the stocking rate was greater (P < 0.01) in the S than in the F (2290 vs. 1450 kg BW/ha). Length of the grazing period and the number of grazing d/ha were not different (P > 0.10) between S (35 d and 259 d/ha) and F (39 d and 245 d/ha), but ADG was greater (P < 0.01) during the S as compared to the F (1.02 vs. 0.57 kg). As a result, BW gain/ha were greater (P < 0.01) during the S than in the F (264 vs. 140 kg/ha). Under intensive short-duration grazing management, fescue pastures can be used to extend the traditional SGP winter wheat grazing season and would result in greater BW gain/calf. Shifting land resources from wheat to fescue production did not decrease gross returns to the enterprise but did change the month of the year calves would be purchased and sold.

Key Words: Stocker Cattle, Wheat Pasture, Fescue

W113 Growth and reproductive performance of heifers grazing Jesup tall fescue varying in endophyte status. M. E. Drewnoski*, E. J. Oliphant, J. T. Green, jr, M. E. Hockett, and M. H. Poore, *North Carolina State University*, *Raleigh*.

The objective of this study was to investigate the effects of endophyte free (E-), endophyte-infected (E+) and novel endophyte-infected (EN) Jesup tall fescue on the ADG and reproductive performance of heifers. The trial was conducted over three consecutive years. In early December of each year, 48 Angus cross heifers (initial body wt 266 kg) were randomly assigned to treatment (trt) and strip-grazed on stockpiled E+, E- or EN fescue. In late February, heifers were removed from pastures and fed trt hay. In late March, heifers were synchronized using a controlled intravaginal drug-releasing device, (CIDR®) for 7d followed by injection with PGF2α. Heatmount detectors (Kmar®) and observation for behavioral estrus were used to detect estrus for three estrous cycles. Heifers were artificially inseminated 8 to12 hrs after the onset of standing estrus. In mid-April heifers moved back on to trt pasture and rotationally grazed until late June. At the end of the trial, heifers had been maintained on E+, E- or EN (pasture or hay) for a total of 152, 188 and 191 days in years 1, 2, and 3, respectively. Conception was determined by transrectal ultrasonography at approximately 30, 60 and 90 days after synchronization. When grazing stockpiled fescue, pasture ADG of heifers did not differ among the trt (P = 0.13). Winter gains were 0.50, 0.57 and 0.51 kg/d (SE ± 0.04) for E+, E- and EN, respectively. However, during the late spring, heifers on EN and E- had higher pasture ADG than the heifers on E+ (P < 0.01). Spring gains were 0.24, 0.75, and 0.71 kg/d (SE ± 0.03) for E+, E- and EN, respectively. Response to synchronization and conception to synchronization did not differ among trt (P = 0.21; P = 0.34). The number of services to conception did not differ among trt (P = 0.39) and was 2.24, 2.34 and 1.99 for E+, E- and EN, respectively. Pregnancy rate did not differ among trt (P = 0.63) and was 54, 65, and 65 % for E+, E- and EN, respectively

Key Words: Reproduction, Endophyte, Heifer

W114 Comparison of bloat potential between hard red and soft red winter wheat. M. S. Akins*[1], E. B. Kegley[1], K. P. Coffey[1], K. S. Lusby[1], W. K. Coblentz[2], R. K. Bacon[1], J. C. Moore[1], J. D. Caldwell[1], and J. V. Skinner Jr.[1], [1]*University of Arkansas*, *Fayetteville*, [2]*USDA-ARS*, *Marshfield, WI*.

Some aspects of wheat pasture bloat have been researched extensively, but little research has evaluated the effect of wheat type on bloat. Forty-eight Angus heifers (238 ± 12 kg BW) and 8 Gelbvieh by Angus ruminally cannulated heifers (515 ± 49 kg BW) grazed 1-ha pastures of either hard red (HR) or soft red (SR) winter wheat (*Triticum aestivum* L.) to evaluate the effect of wheat type on bloat potential. Cattle grazed from November 11 to 22 and from November 26 to December 7, 2006 in a crossover design. Bloat was scored at 1000 and 1600 daily. Rumen samples were taken the last 2 d of each period at 0600, 1200, and 1800, and then evaluated for pH, foam production/strength, and consistency. Forage availability was not different ($P > 0.05$) between HR and SR. Respective initial and final forage availabilities were 1385 and 1071 kg/ha for HR, and 1504 and 901 kg/ha for SR. Overall, the stocker calves bloated 2.1% of the observations with no difference between HR and SR ($P = 0.52$). Rumen fluid pH did not differ between HR and SR ($P = 0.89$) at any point in the day (overall mean = 5.95). Consistency of the rumen fluid differed ($P < 0.0001$) across wheat types. Fluid from heifers on SR flowed 7.4 cm and HR flowed 9.5 cm in a consistometer. There was also a type by time interaction ($P = 0.03$) with SR at 1200 and 1800 being more viscous than SR at 0600 and HR at all times. Foam production as determined by bubbling CO_2 gas through rumen fluid was greater ($P = 0.01$) for SR (9.1 cm) compared to HR (5.7 cm). Foam strength measured as a percentage of initial foam height was greater ($P = 0.01$) for SR (45%) than for HR (28.5%). Differences ($P = 0.001$) between sampling times occurred, with foam strength at 0600 (18%) being less than at 1200 (43%) and 1800 (48%). Therefore, SR had a higher bloat potential than HR based on rumen fluid measurements, but no differences were observed in the frequency of bloat in stocker cattle.

Key Words: Wheat Pasture Bloat, Hard Red, Soft Red

W115 The effect of initial spring grazing date and stocking rate on sward profile during the main grazing season. E. Kennedy*[1,2], M. O'Donovan[1], F. O'Mara[2], and L. Delaby[3], [1]*Teagasc*, *Dairy Production Research Centre, Moorepark, Fermoy, Co. Cork, Ireland*, [2]*School of Agriculture, Food Science and Veterinary Medicine*, *UCD, Belfield, Dublin, Ireland*, [3]*INRA*, *UMR Production du Lait St. Gilles, France*.

The objective of this study was to establish the effect of initial spring grazing date and stocking rate on sward profile of *Lolium perenne* during the main grazing season. Sixty-four spring calving dairy cows were randomly assigned to 4 grazing treatments. The treatments were comprised of 2 swards, early (E) and late (L) grazed. Two stocking rates (SR), high (H) and medium (M), were applied across each sward. The early grazed sward was created by grazing half the area once between 16 February and 4 April. The remaining area was ungrazed from the previous October (late grazed sward). The SR imposed were 5.5 cows/ha (EH), 4.5 cows/ha (EM), 6.4 cows/ha (LH) and 5.5 cows/ha (LM). The study was completed over 4×21–day rotations from 16 April to 3 July 2004. Measurements reported were taken during the 2 (R2) and 4 (R4) grazing rotations. Pre–grazing herbage mass > and <4cm was measured. Pre and post–grazing extended tiller heights (ETH) and extended sheath heights (ESH) were measured on 100 tillers in each treatment paddock. The morphological composition of herbage for each treatment was ascertained weekly by cutting a sample from ground level with a scissors. Tiller density was also calculated.

Data were analyzed using analysis of variance. Pre–grazing sward height, ETH, ESH, DM yield > and < 4cm were significantly higher for the LH and LM swards during R2. However, the leaf:stem ratio was higher for the early grazed swards. Post–grazing measurements were higher (P<0.001) for the late grazed sward during R2. The leaf % was higher on the early grazed swards (P<0.05) however leaf yield (P<0.05) was higher on the late grazed swards. Dead % and yield were lower on the early grazed sward during R2. There were no differences in morphological composition or pre and post grazing measurements during R4. These results suggest that swards should be grazed early in spring and stocked at a medium SR from April to July.

Key Words: Grazing Date, Stocking Rate, Sward Profile

W116 Comparing finishing beef cattle performance and forage characteristic of ryegrass (*Lolium perenne*), rye (*Secale cereale*) and oats (*Avena sativa*). A. C. Pereira*, E. J. Bungenstab, J. C. Lin, B. Gamble, S. P. Schmidt, C. Kerth, and R. B. Muntifering, *Auburn University*, *Auburn, AL*.

Ryegrass (*Lolium perenne*), rye (*Secale cereale*) and oats (*Avena sativa*) were compared as pasture sources for forage-finished beef. Replicate 1.42-ha paddocks (2 per forage) were established and stocked with three Angus × Continental crossbred steers (374 kg ± 5.54 initial BW) per paddock for an 84-day finishing phase. All steers had access to salt and minerals free choice. Grazing was initiated on Jan. 19, 2006, when average forage mass reached at least 1000 kg/ha. Forage mass and nutrient composition were determined by clipping 0.25-m^2 quadrats (n=8 per paddock) prior to the beginning of grazing and continued every two weeks during the trial. Stocking rates were adjusted following quadrat clipping by using put-and-take steers to maintain forages in the vegetative stage. Comparisons of animal performance ended when steers reached 530 kg. Statistical analyses were performed using the PROC GLM procedure in SAS. Daily gain per animal (1.81 kg/d) did not differ ($P > 0.10$) among treatments. rye compared with oats and ryegrass had more CP (18.9%, 17.5% and 17.6% respectively; $P < 0.05$), but ryegrass had less ADF (19.3%, 25.4% and 23.3%; $P < 0.05$) and NDF (37.7%, 46.7% and 44.5%; $P < 0.05$) compared with rye and oats. Total gain per ha was less for ryegrass compared with rye and oats (322 kg/ha, 394 kg/ha and 399 kg/ha; $P < 0.05$). Pasture with oats and rye increase beef production per hectare compared to ryegrass by increasing stocking rate without decreasing daily gain or diet quality.

Key Words: Small Grain, Finishing, Pasture

W117 Performance of stocker cattle grazing two sorghum × sudangrass hybrids under various stocking rates. K. C. McCuistion*[1], F. T. McCollum[2], L. W. Greene[3], B. W. Bean[2,3], and R. VanMeter[3], [1]*Texas A&M University*, *Kingsville*, [2]*Texas Cooperative Extension*, *Amarillo*, [3]*Texas Agricultural Experiment Station*, *Amarillo*.

Summer annual forages are a practical roughage source for stocker cattle operations on the Texas High Plains because of their high yielding potential and energy content. The objective of this study was to describe the relationship between weight gain, stocking rate (SR), and forage quantity and quality for two types of sorghum × sudangrass (SS) hybrids (*Sorghum bicolor* (L.) Moench) using regression analysis. Steer calves (231 ± 4 kg) were grazed for 84 d during the summers of 2004 and 2005. Twelve experimental pastures (6 per SS type) were planted to a brown midrib (BMR) or photoperiod sensitive (PS) SS. Each pasture was assigned a different SR ranging from 2.33 to 4.10 AU × ha^{-1} × 84 d^{-1}. Initial, final and 28 d incremental weights were taken and used to calculate ADG and gain/ha. Forage was sampled on weigh days to determine forage availability, in vitro true digestibility (IVTD), and crude protein (CP) levels over the grazing season. Forage availability was reduced as SR increased after 56 and 84 d of grazing ($P < 0.01$). Stocking rate did not affect IVTD ($P = 0.20$) or CP ($P = 0.43$). Average daily gains were not affected by SR during the first 28 and 56 d of grazing ($P > 0.31$); this implies that gains are less sensitive to SR because forage quantity and quality are uniformly higher earlier in the grazing season. Gain/ha increased linearly in response to SR during the first 28 ($R^2 = 0.60$) and 56 d ($R^2 = 0.80$) of grazing. After 84 d of grazing and a more complete utilization of forage resources, the response of ADG and gain/ha was curvilinear in nature. At light to moderate SR, ADG and gain/ha were higher for the BMR; whereas the PS maintained ADG and gain/ha at higher SR. Our results indicate that cattle grazing these forages were capable of gaining over 1 kg × $head^{-1}$ × d^{-1} and up to 420 kg/ha over an 84 d grazing season but response was dependent on SR.

Key Words: Brown Midrib, Sorghum × Sudangrass, Stocking Rate

W118 Nutritive value of marafalfa grass under tropical dry forest conditions. T. Clavero* and R. Razz, *Facultad de Agronomia. Universidad del Zulia*, *Maracaibo, Zulia, Venezuela*.

Marafalfa grass (*Pennisetum purpureum* × *Pennisetum glaucum*) is a high quality tropical grass which has potential as forage for ruminants but questions remain about quality response to defoliation management. A plot study undertaken on the tropical north coast of Venezuela, assessed the effect of defoliation interval on herbage quality of marafalfa grass. The study included three defoliation frequencies (3, 6 and 9 weeks). Treatments were replicated three times in a randomized block design. Measurements included total nitrogen (TN), *in vitro* dry matter digestibility (IVDMD), acid detegent fibre (ADF), neutral detergent fibre (NDF), lignin (L) and total non-structural carbohydrates (TNC). Data were subjected to analysis of variance, using general linear models procedures of SAS statistical package. Treatments means were constrasted using Tukey test. Nutritive quality of marafalfa grass declined from three to nine weeks of growth. At each interval TN content declined significantly ($P \leq 0.05$). ADF and L only increased significantly ($P \leq 0.05$) between six and nine weeks. The highest value of IVDMD (62.45%) was obtained on three weeks of growth and declined on 10.35 digestible units from 3 to 9 weeks. TNC concentrations increased linearly as defoliation interval increased. Values for TNC concentrations ranged from 13.5 to 20.1 %, for 3 and 9 weeks, respectively. This study showed that the quality of marafalfa grass becomes less favorable with advanced maturity, this could be due to the rapidly increase and accumulation of dead leaf tissue and the lignification of the cell walls. It is suggested that marafalfa grass be harvested at about six weeks of growth to optimize nutritive value.

Key Words: Marafalfa Grass, Nutritive Value, Defoliation

W119 Comparing wether kids on summer cultivated pasture and mesquite rangeland with and without maize grain supplement. S. Pagan-Riestra*[1,2], J. P. Muir[1], K. A. Littlefield[1,4], and S. M. Weiss[3], [1]*Texas Agricultural Experiment Station*, *Stephenville*, [2]*Texas A&M University*, *College Station*, [3]*University of the U.S. Virgin Islands Experiment Station*, *Kingshill, St. Croix*, [4]*Tarleton State University*, *Stephenville, TX*.

Cultivated pastures and supplements are needed to complement rangeland-based goat production in warmer regions of North America during the hot and dry months of June through September. To address this need, growing Spanish X Boer wether kids (average 25 kg) grazing cutlivated pasture (primarily annual legumes and *Amaranthus retroflexus*) were compared to kids on honey mesquite native rangeland (NR; *Prosopis glandulosa* var. *glandulosa*) with an understory dominated by little bluestem (*Schizachyrium scoparium*) during the summers of 2002 and 2003 in north-central Texas. Wethers within both pasture and rangeland were supplemented with maize meal at 0, 0.5, or 1.0% BW. Herbage biomass in the cultivated pasture peaked in July whereas biomass in the NR tended to peak in August. Kids supplemented with 0.5% BW maize on the rangeland had 61% greater average daily gains (ADG) than unsupplemented animals whereas those on cultivated pasture had to be supplemented at 1.0% BW maize before showing an increase in ADG (31%) compared to unsupplemented animals. Unsupplemented wether kids on rangeland gained only 30.5% the ADG of kids fed a balanced feedlot diet (159 g ADG) while kids on cultivated pasture gained 53.3% of those fed a balanced feedlot diet, indicating that neither forage-based system was able to provide the nutrition needed to achieve maximum gain potential. Improved pasture and maize meal supplement both have potential for increasing wether kid ADG compared to rangeland during dry hot summer months.

Key Words: Wether Kids, Improved Pastures, Corn Supplement

W120 Cactus pear cladodes as a source of forage for growing-finishing lambs in Central Mexico. G. Aranda-Osorio*, C. A. Flores-Valdez, and M. Cruz-Miranda, *Universidad Autonoma Chapingo*, *Chapingo, Mexico*.

The objective of this study was to evaluate the effect of cactus pear (nopal) cladodes in diets for growing-finishing lambs on dry matter intake (DMI), total and average daily gain (TLWG and ADG), feed conversion (FC) and profitability (P). Fifty four male lambs (Corriedale × Criollo) with an average initial liveweight of 20.2 kg (± 3.2 kg) were used. Triads of lambs were formed with similar liveweight and housed in a pen (experimental unit), which were randomly alloted to the following treatments: 1) T0% inclusion of Nopal (Control); 2) T15% Nopal, cactus pear at 15 % (DM basis) of the ration, and 3) T30% nopal, cactus pear at 30 % (DM basis) of the ration. The diets were formulated in order to fulfill the nutritional requirements for a growing-finishing lambs according to NRC (1985). The experiment was a completely randomized design with three treatments and six replicates. The cladodes were chopped (approximately 2.5 cm2 and mixed by hand with the diet in the feedbunk at each feeding. Lambs were fed twice a day, at 08:00 h and 16:00 h. The experiment lasted 71 days (adaptation: 14 days, experimental period: 56 days). The inclusion of 15 or 30 % cactus pear in dry matter basis represented 55 and 75 % as fed basis for T15% and T30%, respectively. Results showed that initial liveweight was similar (P>0.01) among treatments, as well as the ADG between T0% (34.54 kg) and T15% (33.95 kg), but T30% (30.71 kg) was lower (P<0.01). DMI was consistently similar (P>0.01) between T0% (0.928 kg) and T15% (0.993 kg) and higher (P<0.01) than T30% (0.615 kg). Average feed conversion was similar (P>0.01) between T0% (5.14) and T15% (5.09) but higher (P<0.01) than T30% (3.44). Lambs fed with high ratio of cactus pear (T30%) were more efficient in converting feed to live weight. The inclusion of cactus pear reduced feed cost by approximately 48 and 65 % for T15% and T30%, in relation to T0%. Thus, live weight gain cost was reduced by about 29.1 and 64.3 % in T15% and T30% in relation to T0%. The inclusion of cactus pear between 15 and 30% may represent an important alternative to feed growing-finishing lambs without affecting animal performance and, on the other hand, may reduce production costs.

Key Words: Cactus Pear, Forage, Lamb Perfomance

W121 Supplementation effects of Calliandra (Calliandra calothyrsus) on weight gains and efficacy of control of gastrointestinal nematodes in weanling goats. A. Acero*, E. Valencia, and A. A Rodríguez, *University of Puerto Rico, Mayaguez Campus*, *Mayaguez, Puerto Rico*.

Information on shrub and tree legumes for supplemental feeding and their effects on weanling goat weight gains or efficacy of control of gastrointestinal nematodes (GIN; Haemonchus contortus) are limited. Calliandra (Calliandra calothyrsus) is a tree legume with high protein concentration (CP; 22%) and condensed tannin (CT; 19 to 30%). Its high CP makes it an alternative for supplementing low quality grass diets of small ruminants and its high CT may reduce GIN infestation. An experiment was conducted to determine the effects of Calliandra on average daily gain (ADG) and efficacy against GIN on weanling Boer goats. Eight weanling goats (12.4 kg) were randomly assigned to two treatments; a base diet of guineagrass hay (GH; Panicum maximum Jacq.) and leaves and twigs of freshly cut Calliandra (FC) supplemented at 20% of expected dry matter (DM) intake based on 3% LW. After morning supplementation, goats grazed native pastures ad libitum. Goats were weighed bi-weekly, and throughout the trial, feces and blood (every 21 d) were taken from individual animals to determine fecal egg counts (FEC) and blood pack cell volume (PCV). Crude protein for grazed pastures, GH and FC were 5.4, 5.0, and 14%, respectively. Nuetral detergent fiber averaged 77, 72, and 65% for grazed pastures, GH and FC, respectively. FAMACHA© score were also taken on individual animals every 14 d. Data were analyzed using repeated measures analysis. Supplementation with FC did not have any effect on ADG, FAMACHA scores (3.4) and PCV (26%). Fecal egg counts (FEC), however, were significantly lower (p<0.05) in goats supplemented with FC than for GH. Adjusted means were 638.2 eggs/g and 982.1 eggs/g for FC and GH, respectively. This reduction in FEC with FC can reduce the frequent use of antihelmintic. Further studies will compare antihelmintic treatment with varying inclusion rates of FC on weanling goats.

Key Words: Calliandra, Gastrointestinal Nematodes, Boer Goats

W122 Luster measurement in mohair produced by Angora goats. C. J. Lupton*, B. S. Engdahl, F. A. Pfeiffer, and J. W. Walker, *Texas Agricultural Experiment Station*, *San Angelo*.

Luster in mohair is the shiny appearance of the fibers when they are illuminated. This important trait contributes to the different and unique appearance of mohair compared to other animal fibers of similar physical dimensions. Luster is assessed subjectively by breeders, a practice that has resulted in a high level of luster in most Angora goat fleeces. Goniophotometers (GON) are used to provide standard measurements of luster in fibers. A GON test is expensive ($600 per 25 fibers) and is not used by breeders. The objective of this experiment was to evaluate 3 methods for their ability to produce low-cost, accurate measurements of luster. The methods were subjective scoring using 3 experienced individuals and objective measurement using near-infrared reflectance spectroscopy (NIRS, Model 6500M, Foss North America, Eden Prairie, MN) and automatic image analysis (Optical Fibre Diameter Analyser 100 [OFDA], BSC Electronics, Ardross, W. Australia), Three people scored luster (0 = no luster, 5 = excellent luster) in 89 parted fleeces. The correlation (r) between luster scores of the 3 appraisers ranged from 0.54 to 0.64 indicating the scores were not in close agreement. NIRS spectra were measured on greasy and cleansed samples (630) representing a broad range of Angora goat fleeces. Other properties measured on the samples using the OFDA included mean fiber diameter (SD and CV), medullation and opacity. Spectrally and visually different samples (8) were selected from this population (luster range 9.2 to 13.6%) for GON analysis. Standard GON results were used to develop a NIRS calibration equation (SEC and r^2 were 0.9% and 0.7, respectively) and a multiple regression equation ($P < 0.02$ for entry) incorporating fiber diameter and opacity for which r^2 was 0.9 and the SE of predicted luster was 0.6%. Agreement between the NIRS predictions and estimates from the regression equation was not perfect ($r^2 = 0.6$, slope = 0.7). Based on this small (but highly selected) sample, luster in mohair appears to be estimated more precisely and accurately from fiber diameter and opacity data than from NIRS spectra.

Key Words: Angora Goat, Luster, Mohair

W123 Effects of feed restriction and subsequent realimentation on tissue and mohair fiber by growing Angora goats. R. Puchala*, A. Patra, A. L. Goetsch, G. Animut, and T. Sahlu, *E (Kika) de la Garza American Institute for Goat Research, Langston University*, *Langston, OK*.

Forty-eight Angora goat wethers (16.7 ± 0.43 kg initial BW and 6 mo of age) were used in a 24-wk experiment to evaluate effects of level of feed intake on current and subsequent tissue (non-fiber) and mohair fiber growth. In Phase 1, 12 wk in length, different amounts of dehydrated alfalfa pellets were fed to provide ME according to NRC requirements adequate for tissue and mohair fiber growth (g/d) of 0 and 0 (0L), 15 and 1.5 (15L), 30 and 3.0 (30L), 45 and 4.5 (45L), 60 and 6.0 (60L), and 75 and 7.5 (75L), respectively. Alfalfa pellets were consumed ad libitum in Phase 2. Digestibility of OM was similar among treatments in both phases. In both phases ME intake (MEI) increased linearly ($P < 0.05$) with increasing level of DMI in Phase 1 (Phase 1: 5.40, 5.24, 6.00, 7.15, 7.89, and 8.04 MJ/d; Phase 2: 10.93, 11.00, 12.02, 13.50, 13.59, and 16.32 MJ/d for 0L, 15L, 30L, 45L, 60L, and 75L, respectively). Energy expenditure in Phase 1 increased linearly ($P < 0.05$) with increasing level of DMI (3.67, 3.87, 3.91, 4.18, and 5.20 MJ/d for 0L, 15L, 30L, 45L, 60L, and 75L, respectively) and was similar among treatments in Phase 2 (6.45 ± 0.40 MJ/d). Tissue growth increased linearly ($P < 0.05$) with increasing DMI in Phase 1 (15.3, 30.9, 49.2, 58.9, 62.5, and 72.1 g/d) and was similar among treatments in Phase 2 (105.6, 108.3, 91.9, 81.9, 76.0, and 97.0 g/d for 0L, 15L, 30L, 45L, 60L, and 75L, respectively). Mohair fiber growth was similar among treatments in Phase 1 (6.6, 6.6, 6.0, 6.2, 7.8, and 7.0 g/d) and in Phase 2 (6.6, 6.8, 5.5, 6.1, 9.2, and 7.3 g/d for 0l, 15l, 30l, 45l, 60l, and 75l, respectively). mohair diameter increased linearly ($p < 0.05$) with increasing dmi in phase 1 (21.7, 21.8, 22.1, 23.4, 23.8, and 23.0μm) and in phase 2 (25.4, 25.5, 26.0, 27.1, 27.0, and 27.1μm for 0l, 15l, 30L, 45L, 60L, and 75L, respectively). In conclusion, growing Angora goats partition nutrients to maintain mohair fiber growth with limited MEI and decrease energy expenditure to lessen the ME requirement for maintenance, resulting in compensatory tissue growth upon realimentation.

Key Words: Angora Goats, Feed Restriction, Mohair

W124 Effects of selection for increased juniper consumption on body weight and mohair production of Angora goats. F. A. Pfeiffer*, E. S. Campbell, B. S. Engdahl, T. D. Lovett, C. J. Lupton, C. A. Taylor, D. F. Waldron, and J. W. Walker, *Texas Agricultural Experiment Station*, *San Angelo*.

Juniper infestation is undermining the productivity of rangelands in the Edwards plateau region of western Texas. Angora goats have demonstrated their ability to consume considerable quantities of low quality browse plants including juniper. A selection experiment for above- (high, H) and below-average (low, L) juniper consumption in Angora goats has been in progress for 4 yr. Juniper consumption was measured using fecal near-infrared reflectance spectroscopy. An objective of the experiment was to establish the effects of the selection protocol on BW, mohair production, and fiber characteristics. Mature females (age > 1.5 yr, 767 records) and kids (114 records) were weighed and shorn twice a year (February and August) having been maintained for most of the year in the same range environment. Yearling males (40 records) were removed from the range to participate in a central performance test in which weight gain was also measured. Raw fleeces were weighed and analyzed for clean yield, fiber diameter, staple length, medullation, and curvature (a measure of crimp). Clean mohair production efficiency ranged from 0.027 to 0.052 to 0.073 kg/kg BW for kids, mature females, and pen-fed yearling males, respectively, with no differences ($P > 0.05$) between H and L goats in any group. Mature H females produced slightly finer (1 micron, $P < 0.005$) mohair with correspondingly higher (1 deg/mm, $P < 0.001$) curvature than L goats. The opposite trends were present in the kids, those animals resulting from the most selection, and no difference ($P > 0.55$) was present between the fiber diameters of H and L male goats. There was a tendency ($P = 0.07$) for L male goats to have higher BW than H goats. For all other fiber traits, H did not differ ($P > 0.1$) from L goats. To date, selection for increased and decreased juniper consumption in free-ranging Angora goats has produced either very small or no differences in BW or fiber traits.

Key Words: Angora Goat, Mohair, Juniper

W125 Participant demographics of a web-based certification program for meat goat producers. R. C. Merkel*, T. A. Gipson, S. P. Hart, and T. Sahlu, *E (Kika) de la Garza American Institute for Goat Research, Langston University*, *Langston, OK*.

In 2006, a Langston University-led consortium of 11 universities and 5 meat goat producer groups unveiled an on-line training and certification program (http://www2.luresext.edu/training/qa.html). The program consists of 22 learning modules. Participants take pre- and post-tests to pass the 16 required and a minimum of 3 elective modules for certification. As of February, 2007, 256 participants from 9 countries (US – 245, Canada – 3, India – 2, Australia, Jamaica, Malaysia, Nigeria, Pakistan, Romania – 1 each) have registered for the program. Thirty-nine states are represented with the top 5 states representing 55% of total participants (OK – 59, MO – 24, TX – 20, TN and KS – 16 each). Sixty-five percent of respondents classified themselves as part-time farmers/ranchers, 19% full time, and 16% no response. Fifty-one percent classified farm size as less than 40 acres and only 16% > 160 acres. Average herd size for 54% of respondents was 49 or fewer animals (34% < 25 goats). Only 13% of respondents owned >100 goats. Males comprised 56% of participants and females 37%, with the remainder not responding. Sixty-three percent of respondents reported membership in the American Boer Goat Association; 16% American Meat Goat Association; 13% American Kiko Goat Association; 6% U.S. Boer Goat Association; and 4% International Kiko Goat Association. Demographic data suggest that an on-line certification program is an acceptable method to provide information to small holder meat goat producers.

Key Words: Goats, Certification, Internet

W126 Effectiveness of a web-based certification program for meat goat producers. S. P. Hart*, R. C. Merkel, T. A. Gipson, and T. Sahlu, *E (Kika) de la Garza American Institute for Goat Research, Langston University*, *Langston, OK*.

In 2006, a Langston University-led consortium of 11 universities and 5 meat goat producer groups unveiled an on-line training and certification program (http://www2.luresext.edu/training/qa.html). The program consists of 22 learning modules in which participants take pre- and post-tests (requiring a score of ≥85%) to pass the 16 required and a minimum of 3 elective modules for certification. As of February, 2007, 256 participants have registered for the program. Least square means were lower for pre- vs post-tests (68 vs 90% ± 1.53; $p<0.001$) with an average increase in score of 22 percentage points. Largest increases in pre- vs post-test scores were seen in the Reproduction (48 vs 89% ± 3.7) and Nutrition (54 vs 90% ± 3.0) modules with lowest increases in test scores seen in the Livestock Guardian Dogs (77 vs 91% ± 5.4), Herd Health Procedures and Prevention (73 vs 90% ± 4.6), and Marketing (75 vs 87% ± 2.7) modules. Knowledge transfer was evident through the increases in test scores. These data suggest that an on-line testing and knowledge dissemination program is acceptable for many goat producers as a means to increase knowledge of goat production practices.

Key Words: Goats, Certification, Internet

W127 Goat conferences in Arkansas. J. A. Pennington*, *University of Arkansas Cooperative Extension Service*, *Little Rock*.

Surveys were conducted of goat conferences in Arkansas to determine needs and characteristics of producers as the conferences have evolved from a single youth dairy goat conference, initiated in 1994, to ten goat conferences throughout the state in 2006. Average attendance in 2006 at the conferences was 92; attendance on Saturdays averaged 121 and attendance on weekdays averaged 63. Conference attendees were primarily interested in meat goats (68% meat goats, 14% dairy goats, and 18% combination of meat goats, dairy goats, and/or sheep). Additionally there were several county workshops. Surveys of goat producers at the conferences indicated that the topics most requested were 1) marketing of the goats, 2) controlling internal parasites, and 3) feeding and forages for goats. Other topics requested included diseases and their treatment, kidding management, predator control, breeding and genetics, fencing, and product preparation. Youth activities for fitting and showmanship were included in all Saturday programs which had a registration fee. Speakers at the conferences include state extension agents and specialists, local producers, usually a goat specialist from an adjoining state, and related industry personnel. In 2006, five no-fee conferences with the Natural Resources Conservation Service consisted of lecture topics in the a.m. and a farm visit in the p.m. to demonstrate forages, facilities, and fencing. Evaluations for conferences on Saturdays during the past four years ranged from 4.2 to 4.7 out of 5.

Key Words: Conference, Extension, Goat

W128 Estimation of meat goat carcass composition using regression analysis. K. E. Logan*, H. N. Zerby, S. J. Moeller, T. J. Fraley, and D. A. Mangione, *The Ohio State University*, *Columbus*.

Percentage Boer meat goats (N = 135) ranging in live weight from 15.5 to 45 kg (avg. = 29.5, std. dev. = 6.6 kg) were harvested to assess the impact of live and carcass measurements as predictors of carcass primal (P) and total muscle (TM) weights. Goats were obtained from two sources: auction market (N = 104) and a local exhibition (N = 31). Live weight (LW), carcass weight (CW), backfat thickness (BF), ribeye area (REA), weight of primal cuts (leg, loin, rack, and shoulder), and complete carcass dissection (weight of fat, bone, and muscle) were recorded. Data were analyzed as a complete set and within CW subclasses using stepwise regression ($P < 0.15$). Dependent variables were P and TM weights. Model R^2 for estimation of P from significant independent variables LW, REA and BF was 0.91 with a partial R^2 of 0.86 for LW. The R^2 for estimation of P from CW and BF was 0.97 with a partial R^2 of 0.97 and 0.002, respectively. Estimations of TM from a model including LW (partial $R^2 = 0.81$) and REA (partial $R^2 = 0.07$) or CW (partial $R^2 = 0.94$) and REA (partial $R^2 = 0.005$) were slightly reduced when compared with estimation of P. Subset analyses were conducted within the following CW intervals; < 20 (N = 11), 21 to 25 (N = 19), 26 to 30 (N = 49), 31 to 35 (N = 18), 36 to 40 (N = 11), 41 to 45 (N = 12) and ≥46 (N = 11). Model R^2 within subset for estimation of P from CW, REA and BF ranged from 0.46 to 0.80 and was lowest in the 26 to 30 kg weight range. Partial R^2 for REA were significant in the < 20 ($R^2 = 0.06$) and 26 to 30 ($R^2 = 0.05$) CW ranges only for the estimation of P. Backfat thickness contributed significant partial R^2 of 0.04, 0.25, and 0.06 in CW ranges 26 to 30, 31 to 35, and

36 to 40 kg, respectively for estimation of P. Model R^2 were reduced in all CW subclasses when estimating TM, regardless of significant independent effects in the model. Results indicate that CW and LW account for a large proportion of total variation in P and TM across the data set and within CW subclasses, and the incremental increase in R^2 is small when adding BF and/or REA to the prediction model.

Key Words: Composition, Dissection, Goat

W129 Effect of hydrodynamic pressure processing on chevon quality characteristics. K. R. Eega*[1], J. H. Lee[1], M. B. Solomon[2], T. D. Pringle[3], K. W. McMillin[4], and G. Kannan[1], [1]*Fort Valley State University*, *Fort Valley, GA*, [2]*USDA/ARS Food Technology and Safety*, *Beltsville, MD*, [3]*University of Georgia*, *Athens*, [4]*Louisiana State University*, *Baton Rouge*.

Hydrodynamic pressure processing (HDP) technology, which involves exposure of packaged meat to a supersonic shock wave under water, created by a small amount of explosive, has been shown to improve meat tenderness; however, its effect on chevon tenderness has not been studied. The objective of this experiment was to determine the effects of HDP on the quality characteristics of boneless chevon leg steaks. Eighteen male Spanish goats (8 mo of age) were slaughtered and the carcasses kept at 2°C for 24 h, fabricated, and the leg primal cuts sliced into 2.5 cm-thick steaks. The bone from each slice was removed and the steaks were vacuum packaged and frozen. The steaks were transported frozen to the Food Technology and Safety Lab at Beltsville, MD, where they were thawed overnight (4°C), and then repackaged for HDP processing. Steaks from the left leg of each carcass were subjected to HDP treatment and those from the right were kept as untreated controls (n = 18/treatment). Cooking loss, Warner-Bratzler shear force value, thiobarbituric acid reactive substances (TBARS), and color values were determined on the semimembranosus muscles of both treated and control steaks. Hydrodynamic pressure processed steaks had lower shear force values compared with control steaks ($P < 0.05$). Cooking loss tended to be higher ($P < 0.1$; SEM = 1.11) in treated steaks (31.9%) compared with control steaks (29.6%). The TBARS values were 1.2 and 1.1 mg melonaldehyde/kg sample, respectively, in treated and control steaks. The CIE L*, a*, and b* color values determined after a 40-min bloom period were not different between HDP-treated and control steaks. The results indicate that HDP processing can improve the tenderness of chevon without significantly affecting other meat quality characteristics.

Key Words: HDP Processing, Chevon, Tenderness

W130 Quality characteristics of jerky made from Hydrodynamic Pressure processed (HDP) chevon and beef. K. R. Eega*[1], J. H. Lee[1], M. B. Solomon[2], T. D. Pringle[3], K. W. McMillin[4], and G. Kannan[1], [1]*Fort Valley State University*, *Fort Valley, GA*, [2]*USDA/ARS Food Technology and Safety Laboratory*, *Beltsville, MD*, [3]*The University of Georgia*, *Athens*, [4]*Louisiana State University*, *Baton Rouge*.

Hydrodynamic pressure (HDP) processing has been reported to improve tenderness of beef and pork, but its effect on goat meat (chevon) has not been studied. This experiment was conducted to determine the effects of HDP processing on quality characteristics of chevon and beef jerky. Vacuum packaged frozen boneless chevon leg cuts (n = 32) and cuts from beef top rounds (n = 32) were thawed and either subjected to HDP processing or kept as untreated controls (n = 16/treatment/species). A commercial seasoning was used to produce jerky from Semimembranosus muscle strips ($10 \times 5 \times 0.5$ cm) obtained from each cut. The Commission Internationale de I'Eclairage (CIE) L*, a*, and b* color values of chevon jerky were higher in the HDP-processed group compared with the control group, and the average color values were higher ($P < 0.01$) in chevon compared with beef jerky. Dry matter and ash contents were higher in chevon compared with beef jerky ($P < 0.01$), while the fat content was not influenced by animal species. Tenderness scores from an eight-member trained panel were higher ($P < 0.01$) for beef (4.7 ± 0.11) compared with chevon jerky (3.9 ± 0.11), with jerky samples from HDP-processed beef receiving the highest tenderness ratings. Juiciness and flavor scores were also higher ($P < 0.01$) for beef jerky compared with chevon jerky. The TBARS values of vacuum-packaged chevon jerky increased with storage time (30, 60, or 90 d at 2°C), while the values did not change in beef jerky (species × storage time, $P < 0.05$). Yeasts and molds were not detected and the total plate counts were generally < 1.00 $\log_{10}$ CFU/g in jerky samples during the 90-d storage period. Results showed that HDP processing significantly improved the quality characteristics of jerky. Jerky made from beef had better organoleptic and storage properties than chevon jerky.

Key Words: Chevon, HDP Processing, Jerky

W131 Chemical composition and quality of chevon as influenced by a diet high in condensed tannins. M. Vanguru*, J. H. Lee, D. A. Moore, B. Kouakou, T. H. Terrill, and G. Kannan, *Fort Valley State University*, *Fort Valley, GA*.

Sericea lespedeza, a legume high in condensed tannins (CT), has been reported to decrease nematode infections in meat goats, although its effect on the quality of meat has not been studied. This study was conducted to determine the effects of a high CT-containing diet on goat meat (chevon) quality characteristics. Twenty Boer × Spanish goats (6 mo of age; BW = 19.2 ± 0.74 kg) were assigned to pens (5 goats/pen), and each pen was allotted to one of two dietary treatments of 75% hay and 25% supplement: sericea hay plus a corn-based supplement (18 % CP) consisting predominantly of corn and soybean meal for 14 wk (SER) or Bermuda grass hay plus the corn-based supplement (BER; n = 10 goats/treatment). At the end of the feeding trial, goats were slaughtered using standard procedures. After 24 h of cooler storage (4°C), the carcasses were fabricated to obtain 2.5-cm thick loin chops (Longissimus dorsi, LD) for meat quality analysis. No significant differences were found between SER and BER groups in moisture (73.2 vs 72.8%), protein (24.7 vs 23.8%), fat (3.11 vs 2.71%), and ash (1.83 vs 1.59%) percentages of LD muscles. The L* (lightness), a* (redness), and b* (yellowness) color values were not affected by the dietary treatment, although the L* values tended to be higher ($P < 0.10$) in loin chops from the SER group compared with those from the BER group. No differences ($P > 0.05$) were found in the thiobarbituric acid reactive substances in LD muscles between the two treatment groups. The Warner-Bratzler shear force values (4.76 vs 4.66 ± 0.43 kg) and cooking losses (19.6 vs 19.1 ± 1.13 %) of loin chops were also not influenced by the dietary treatments. The results indicated that a diet containing high levels of CT did not influence the composition and quality of meat in goats, although high CT diets may affect meat color.

Key Words: Chevon Quality, Goats, Sericea Lespedeza

W132 The small ruminant nutrition system: Development of a goat submodel. A. Cannas*[1], L. O. Tedeschi[2], and D. G. Fox[3], [1]*University of Sassari*, *Sassari, Sardinia, Italy*, [2]*Texas A&M University*, *College Station*, [3]*Cornell University*, *Ithaca, NY*.

The Small Ruminant Nutrition System (SRNS) is a computer model based on the structure of the Cornell Net Carbohydrate and Protein System for Sheep. A version of the SRNS for goats is under development. In the SRNS for goats, energy and protein requirements are predicted based on the equations developed for the SRNS for sheep, modified to account for specific requirements of goats. Energy requirements for basal metabolism of dairy goats averaged 125%, 117%, and 105% of those of sheep for dairy goats, Angora goats, and indigenous goats, respectively. Maintenance MP requirements were the same as used for sheep regarding urinary and fecal endogenous nitrogen, but hair and scurf were modified for goats. NE requirements for lactation were specific for goats. The relationships among body condition score (BCS, 0-5 scale), full BW (FBW), body composition and growth requirements developed for sheep was used for goats. The SRNS submodel to predict supply of nutrients was used for goats as well, except for the prediction of DMI, which was based on equations specific for goats. The evaluation of the SRNS for goats based on literature data showed that while in different breeds of goats it predicted very accurately the relationship between BW and BCS at any BCS, but it markedly over-predicted body fat concentration in the empty BW. Based on data gathered from the literature (24 treatment means), the SRNS predicted the growth rate of kids with good accuracy (mean bias was 8 g/d and root of the MSE of the prediction was 26.2 g/d). Further improvements of the goat submodel are planned to account for feed selectivity, body composition of different breeds, physical activity of grazing goats, and environmental effects on requirements and intake.

Key Words: Feeding Systems, Goats, Modeling

W133 Short-term trends of Boer and Kiko bucks in a central performance test. T. A. Gipson*[1], L. Dawson[2], and T. Sahlu[1], [1]*E (Kika) de la Garza American Institute for Goat Research, Langston University*, *Langston, OK*, [2]*Oklahoma State University*, *Stillwater*.

Increasingly meat goat producers in the U.S.A. are basing selection decisions upon performance traits and are relying upon central performance tests to objectively select bucks. Since 1999, the Langston University central performance test (LUCPT) has evaluated 398 bucks representing 70 breeders and 8 states. Two breeds have been tested, Boer and Kiko, the former accounting for 95% of the bucks enrolled. Therefore, the objective of this study was to evaluate the trends of the performance traits over the last 8 years (1999 to 2006) of LUCPT bucks. Traits evaluated were ADG, feed:gain ratio (FE), loin-eye area (LEA), and residual feed intake (RFI). An analysis of covariance was conducted with performance traits as the dependent variables, breed as the independent variable, and linear and quadratic effects of year as covariates. Over the 8 years, ADG increased linearly (yearly rate = 7.3 (g/d)/yr±1.25); FE decreased linearly (yearly rate = -0.08/yr±0.029); LEA increased quadratically (linear yearly rate = 1.15 cm^2/yr±0.223; quadratic yearly rate = -0.10 (cm^2)/yr^2±0.024); and RFI increased quadratically (linear yearly rate = 0.039 (g/d)/yr±0.0162; quadratic yearly rate = -0.005 (g/d)/yr^2± 0.0017). The two latter traits increased then decreased over time so that the traits in 2006 were virtually the same as in 1999. Breed influenced ($P < 0.05$) all performance traits: ADG averaged 277±2.9 for Boer and 206±13.8 g/d for Kiko; FE averaged 6.8±0.07 for Boer and 7.6±0.32 for Kiko; LEA averaged 11.4±0.11 for Boer and 9.2±0.53 cm^2 for Kiko; and RFI averaged -0.03±0.008 for Boer and 0.04±0.038 g/d for Kiko. Phenotypically across breeds, FE was positively correlated ($P < 0.05$) with LEA ($r=0.18$) and with RFI ($r=0.41$) but negatively correlated with ADG ($r=-0.49$). ADG was positively correlated ($P<0.05$) with LEA ($r=0.24$). Generally, ADG increased and FE decreased in desirable directions indicating that meat goat producers may be basing selection upon economically important traits, especially ADG which is easily measured on-test and on-farm. LEA and RFI remained unchanged, indicating that meat goat producers may not consider them important or they do not understand them.

Key Words: Central Performance Test, Goat

W134 Influence of dietary condensed tannins on gastrointestinal tract, skin, and carcass bacterial counts in meat goats. J. H. Lee*, D. A. Moore, M. Vanguru, B. Kouakou, T. H. Terrill, and G. Kannan, *Fort Valley State University*, *Fort Valley, GA*.

Diets high in condensed tannins (CT), such as sericea lespedeza hay, have been reported to reduce gut microbial loads in ruminants. This experiment was conducted to determine the effects of feeding higher levels of CT on gut, skin, and carcass microbial counts in goats. In a Completely Randomized Design, twenty Boer × Spanish kids (6 mo of age) were fed ground sericea (2 pens, SER) or Bermuda grass hay (2 pens; BER), 75% of daily intake for 14 wk with a corn-based supplement (25% of intake) (n = 10 goats/treatment). At the end of the feeding trial, the animals were slaughtered using standard procedures. Skin swab samples were made on the hind legs (5 × 5 cm area) prior to slaughter. Immediately after evisceration, rumen and rectal samples, as well as carcass swab samples were collected to assess bacterial loads. Concentrations of rumen volatile fatty acids were significantly different between dietary treatments. Goats fed sericea hay had higher ($P < 0.05$) contents of butyric (8.66 vs 7.16 mM), isobutyric (1.94 vs 1.44 mM), isovaleric (3.03 vs 2.13 mM), and valeric (1.43 vs 1.07 mM) acids than those fed Bermuda hay; however, the content of acetic acid (78.6 vs 64.4 mM) was higher ($P < 0.05$) in the BER group than in SER group. Generic E. coli (2.24 vs 0.93 $\log_{10}$ CFU/g) counts of rumen contents were higher in the SER group compared with BER group. However, microbial counts in feces were not different between dietary treatments. The aerobic plate counts on skin in the SER and BER groups were 4.58 and 4.46 $\log_{10}$ CFU/cm^2, respectively ($P > 0.05$). Carcass aerobic plate counts were 3.12 and 2.65 $\log_{10}$ CFU/cm^2 in SER and BER groups, respectively ($P > 0.05$). Total coliform and E. coli counts on skin and carcass were estimated to be <1.00 $\log_{10}$ CFU/cm^2. The results indicated that CT in the diet may influence rumen volatile fatty acid composition, but may not reduce the gut bacterial loads.

Key Words: *E.coli*, Goat, Sericea lespedeza

W135 Dietary regimen and gastrointestinal tract microbial loads in meat goats. J. H. Lee*, B. Kouakou, and G. Kannan, *Fort Valley State University*, *Fort Valley, GA*.

Microbial load in the gastrointestinal tract (GIT) can be related to contamination of skin/hide and carcass surfaces in ruminants. Thirty-six Boer × Spanish goats (BW = 17.7 kg) were used to determine the effects of dietary treatment on volatile fatty acid concentrations (VFA) in rumen and microbial loads of GIT contents. Animals were randomly allotted to nine pens, and each pen (4 goats/pen) was assigned to one of three dietary treatments for 90 d (3 pens/treatment): (1) a hay diet, consisting of alfalfa (Medicago sativa) hay alone (H); (2) a 18% CP concentrate diet, consisting predominantly alfalfa meal and yellow corn (C); or (3) a combined diet, consisting of the hay diet for the first 45 d, followed by the concentrate diet (HC). At the end of the feeding trial, goats were slaughtered using standard procedures. Immediately after evisceration, rumen fluid and rectal samples were aseptically collected from each animal to determine the microbial loads. Rumen fluid was also collected and prepared for determination of VFA. No significant differences were found in rumen fluid VFA among treatments, although the acetic acid concentration was high in the H group (66.27 mM), low in HC group (34.61 mM), and intermediate in C group (44.18 mM; $P < 0.05$). The total plate counts were not different ($P > 0.05$) among treatments for rumen fluid and fecal (rectal) samples. The E. coli counts in the rectal samples were lower in the H group (6.43 $\log_{10}$ CFU/g), compared with C (8.21 $\log_{10}$ CFU/g) or HC (8.40 $\log_{10}$ CFU/g) groups. However, no significant differences were found in the E. coli counts of rumen fluid samples among the dietary treatments. The mean (± SEM) rumen E. coli counts were 1.38, 1.65, and 2.51 ± 0.560 $\log_{10}$ CFU/g in H, C, and HC groups, respectively. The results indicated that either concentrate diet or a diet change from hay to concentrate may increase fecal shedding of E. coli in meat goats.

Key Words: Diet, *E. coli*, Goats

W136 Impact of types of pelleted feed and two pellet to hay ratios on the development of urolithogenic compounds in meat goats. K. Sullivan[1], S. Freeman*[1], M. Poore[1], E. van Heugten[1], K. Ange-van Heugten[1], and B. Wolfe[2], [1]*North Carolina State University*, *Raleigh*, [2]*The Wilds*, *Cumberland, OH*.

Goats and giraffes both have documented problems with urolith formation. Since research in giraffes poses logistical challenges, 18 buck goats were used as a model. Our objective was to determine the impact of two commercial pellets used as feed for giraffes (ADF-16, A; and Wild Herbivore, W) and two hay to pellet ratios (80:20, 80H; and 20:80, 20H) in a 2 × 2 factorial design. Total feces and urine were collected over 2 5-d periods separated by 9d for N and mineral balance determination. Fresh urine samples were collected twice during each collection period and evaluated microscopically for urolithic crystal content. Ruminal fluid was collected by rumenocentesis 2 hr post-feeding once at the end of the trial. Analysis of feedstuffs showed % CP, % NDF, % Ca, and % P to be 20.2, 43.9, 1.5, and 0.2 for the alfalfa hay; 19.4, 30.0, 0.8, and 0.7 for A; and 14.2, 54.4, 1.0, and 0.4 for W, respectively. DM and water intake were higher for the 20H than 80H bucks ($P \leq 0.05$ and 0.10, respectively); however, there were no treatment differences in DM digestibility. Retention of N was higher in bucks fed 20H diets ($P \leq 0.05$). Crystals observed were predominantly calcium phosphate. Crystal counts were not influenced by diet; however, crystal scores were higher in animals receiving 20H diets ($P \leq 0.10$). Ruminal NH_3 was higher in A bucks than W while urine pH was higher in W bucks than A. Urine pH was also higher for 80H than 20H ($P \leq 0.05$). Our data suggest that the proportion of hay offered to the goats was a greater influence on urinary calcium phosphate crystals than was pellet type.

Table 1. Impact of hay level and pellet type on meat goats

DM Basis	80HA	80HW	20HA	20HW	
% CP	20.1	19.0	19.5	15.4	
%NDF	41.1	46.0	32.8	52.3	
% Ca	1.3	1.4	1.0	1.1	
% P	0.3	0.3	0.6	0.4	
DMI (g/d)	1042	990	1198	1378	H[1]
H_2O intake (L/d)	2.8	2.9	3.2	3.4	H[2]
% DM dig	67.5	67.7	69.2	66.6	NS
N retention (g/d)	6.9	7.3	10.5	10.8	H[1]
Urine pH	8.6	8.9	8.4	8.7	H[1], P[1]
Crystal score	1.8	2.0	2.8	2.8	H[2]
Crystal count	48.8	136.5	205.6	149.8	NS
Ruminal NH_3 (mg/dl)	24.5	14.0	30.0	11.8	P[1]
Ruminal pH	6.25	6.60	6.31	6.34	NS

[1] $P \leq 0.05$ for H, P [2] $P \leq 0.10$ for H, P

Key Words: Hay to Concentrate Ratio, Meat Goats, Uroliths

Nonruminant Nutrition: Feeder Pig and Sow Nutrition II

W137 Comparison and accounting for differences of three phytase activity assay methods. J. D. Weaver* and X. G. Lei, *Cornell University*, *Ithaca, NY*.

Phytases are now widely used throughout the world as feed additives for simple-stomached animals to increase phosphorus bioavailability and reduce phosphorus content in the excreta. Phytase activity is measured colorimetrically by the complexing of molybdenum with liberated phytate-phosphate. There are three different methods of assaying phytase activity: the molybdenum blue method with reduction of the phosphomolybdate complex by ascorbic acid (method 1), the molybdovanadate method (method 2), and the acetone phosphomolybdate method (method 3). Since different conditions may affect enzyme activity, we compared these three methods in order to characterize the relative impact of each assay condition on the activity outcome. Two commercialzed phytase enzymes, *Aspergillus niger* PhyA and *Escherichia coli* AppA2, were used for the assay comparison. When PhyA samples were analyzed, method 2 gave different ($P < 0.05$) activity values from that of method 1 or 3. In the case of AppA2 enzyme, all three methods gave different ($P < 0.05$) activity values. The greatest disparity was between methods 1 and 2 for AppA2 (2.8-fold, $P < 0.05$), and this difference was attributed to buffer, 39%; pH, 30%; and Triton X-100 and bovine serum albumen, 32%. The lower substrate concentration of method 3 versus method 1 reduced the activity of PhyA by 22%, without affecting the activity of AppA2. The presence of Trtion X-100 and bovine serum albumen in the exraction buffer for AppA2 tended to increase the phytase activity value ($P = 0.06$-0.08). These results help clarify discrepancies between various research groups and assist consumers in choosing a phytase additive.

Key Words: Phytase, Assay, Conditions

W138 Effects of dietary supplementation of an enzyme blend on digestibility of nutrients in the hindgut of growing pigs. F. Ji*[1], D. Casper[2], D. Spangler[2], K. Haydon[3], and J. E. Pettigrew[1], [1]*University of Illinois*, *Urbana*, [2]*Agri-King, Inc.*, *Fulton, IL*, [3]*Prince Agri Products*, *Quincy, IL*.

To measure the impact of a beta glucanase/protease enzyme blend product (EBP) on the digestibility of nutrients in the hindgut of pigs, 12 cannulated barrows (38.2 ± 0.5 kg) were blocked on previous feed intake (FI) and randomly assigned to 1 of 4 treatments using a 4 x 4 latin square design replicated 3 times. Treatments were hydrolyzed casein for measurement of endogenous N flow reported elsewhere, Basal diet (B), B + 0.05% EBP (EBP1), B + 0.10% EBP (EBP2). The B consisted of corn and soybean meal (SBM) having 3.36 Mcal ME/kg and 1.2% total lysine. The periods consisted of 4 d of adaptation, 5 d of fecal collection, 3 d of transition, and 2 d of ileal collection. Pigs were fed and feces were collected twice daily at 12-h intervals. Ileal effluent was collected continuously for 12 h each d. The FI of each square during period 1 was 85% of the minimum FI of 4 pigs during the preliminary period, equalized within square, and increased by 100g/d in each subsequent period. The difference between fecal and ileal digestibility (DFID) and digestibility based on the nutrients entering the hindgut (DNH) were calculated. The DFID of hemicellulose was higher ($P < 0.05$) in B than in EBP1 and EBP2 (Table 1). The DNH of EBP1 and EBP2 was higher ($P < 0.05$) in CP and tended to be higher ($P = 0.06$) in DM than that of B. In conclusion, this study showed that EBP increased the hindgut digestibility of CP but reduced that of fiber in growing pigs fed a corn-SBM diet because of greater intestinal NDF digestibility occurring with EBP.

Table 1. Digestibility (%) of nutrients in the hindgut.

Nutrient	B	EBP1	EBP2	SD[1]
n	11[2]	12	12	
DFID				
DM	17.25	19.68	18.32	3.79
Energy	16.00	18.19	16.96	3.86
CP	9.13	12.86	11.15	4.01
NDF	55.93	45.36	45.93	12.95
Hemicellulose	50.94[b]	37.87[a]	34.19[a]	14.41
DNH				
DM	57.78	62.70	61.14	4.56
Energy	54.41	58.53	56.83	6.42
CP	39.20[a]	50.71[b]	46.67[b]	7.68
NDF	54.38	49.78	50.76	6.47
Hemicellulose	47.00	42.92	39.47	8.22

[1] Pooled SD. [2] One outlier was removed. [a,b]Means with unlike superscripts differ, $P < 0.05$.

Key Words: Enzyme, Digestibility in the Hindgut, Growing Pigs

W139 Effect of sex and feeding level on meat quality and fatty acid profile of backfat of Iberian pigs reared under intensive production systems. M. P. Serrano[1], D. G. Valencia[1], R. Lázaro[1], A. Fuentetaja[2], and G. G. Mateos*[1], [1]*Universidad Politécnica de Madrid*, *Spain*, [2]*Copese*, *Segovia, Spain*.

Iberian (IB) pigs are the ancestral dark-haired pigs of Spain, originally reared under free range conditions and sacrificed at 160 to 180 kg BW. Usually both sexes were castrated. Currently, many IB pigs are reared indoors and fed on concentrates to meet the increasing demand for IB products. We studied in 160 crossbred (Duroc sire x IB dam) pigs the effects of sex (EF, entire females; CF, castrated females; CM, castrated males) and feeding level (*ad libitum* vs. 23% restriction of *ad libitum* feed intake from 42 to 112 kg BW) on meat quality and fatty acid (FA) profile of backfat (BF). From 112 kg BW to slaughter at 152 kg BW, all pigs were fed *ad libitum*. Each treatment was replicated four times (seven pigs). Samples of *Longissimus muscle* (LM) were taken at the last rib level and of BF at tail insertion. No differences were detected between EF and CF for any trait studied ($P > 0.10$). The LM of CM and CF had more fat (8.3 vs. 5.8%; $P < 0.01$) and less crude protein (21.1 vs. 21.7%; $P < 0.05$) and moisture (70.4 vs. 72.3%; $P < 0.01$) than the LM from EF. In all cases the intramuscular fat content of EF was sufficient to generate cured products of high quality. Meat color was not affected by sex ($P > 0.10$). Feeding level did not affect chemical composition or color of LM ($P > 0.10$). Subcutaneous fat was more unsaturated (60.9 vs. 59.9%; $P < 0.01$) in EF than in CM or CF mostly because of the higher linoleic acid content (9.2 vs. 8.6%; $P < 0.01$). *Ad libitum* fed pigs had higher percentage of oleic acid and monounsaturated FA ($P < 0.001$) and lower of stearic acid and saturated FA ($P < 0.001$) than restricted fed pigs. We conclude that entire females are an alternative to castrated males and castrated females to produce Iberian cured products of high quality. Also, a 23% feed restriction from 42 to 112 kg body weight modified slightly the fatty acid profile of backfat but not meat quality.

Key Words: Iberian Pig, Duroc Pig, Pork Quality

W140 Effects of conjugated linoleic acid (CLA) on sow reproductive performance. R. Patterson*, M. L. Connor, and C. M. Nyachoti, *University of Manitoba*, *Winnipeg, Manitoba, Canada*.

The ability of CLA to improve reproductive performance was evaluated using 14 mixed parity Cotswold sows in a completely randomized repeated measured design. Treatments were arranged as a 2x2 factorial with diet (0% or 2% CLA) and parity (I = Immature or M = Mature) as follows: 1) 0%-I n = 3; 2) 0%-M n = 3; 3) 2%-I n = 4; 4) 2%-M n = 4. Diets were fed as gestation rations from d 85 to 112 of pregnancy and for 4 d post-weaning, and as lactation rations from d 112 of gestation until weaning at 17±1 d of age. Blood was collected from sows on gestation d 85, 105, 112 and lactation d 1, 3, 17 and 4 d post-weaning and from piglets on d 3 and 17. Sow BW, back fat depth and feed intake and piglet BW were determined on the same d as blood sampling. Blood samples were analyzed for PUN, IgA and IgG concentrations. BW and back fat depth were used to estimate whole body nutrient status. Dietary CLA had no effect ($P > 0.10$) on sow ADFI and BW during gestation and lactation periods although sows fed CLA-supplemented diets had less back fat than control sows during gestation ($P = 0.05$) but not lactation ($P = 0.15$). Immature sows fed CLA-supplemented diets tended ($P = 0.09$) to lose less back fat than control sows during lactation. Dietary CLA increased sow whole body protein percentage during gestation but not during lactation ($P = 0.05$) but had no effect on whole body lipid content ($P > 0.10$). Piglets nursing sows consuming CLA-supplemented diets were lighter than piglets nursing control sows ($P = 0.06$). However, dietary CLA did not affect total litter weight ($P > 0.10$). Although dietary CLA had no effect on the concentrations of IgA and IgG of sows and piglets ($P > 0.10$), piglets nursing CLA-supplemented sows had greater PUN concentrations compared to piglets nursing control sows at d 3 and 17 of age ($P < 0.01$). While supplementation of sow diets with CLA did not

improve litter performance or immune status pre-weaning, when provided to immature sows, dietary CLA has the potential to diminish deleterious body condition loses associated with lactation.

Key Words: CLA, Sows, Piglets

W141 Apparent and standardized ileal amino acid digestibilities in pea and pea protein isolate fed to growing pigs. F. O. Opapeju, G. Borgesa*, R. Patterson, and C. M. Nyachoti, *University of Manitoba*, *Winnipeg, Manitoba, Canada*.

Four Cotswold barrows (50.41 ± 5.05 kg BW), each fitted with a T-cannula at the distal ileum, were used to determine apparent (AID) and standardized (SID) ileal digestibility of amino acids (AA) in whole pea and pea protein isolate (PPI) from the same batch of whole pea. Pigs were allotted to diets containing either pea or PPI as the sole source of protein and formulated to contain 15.5% crude protein (CP) in a simple crossover design. Pigs were fed twice daily (0830 and 1530) at 2.6 times maintenance energy requirement. The experiment consisted of two 6-d experimental periods. During each period, pigs were adapted to experimental diets for 4 d followed by 12 h of continuous ileal digesta collection on d 5 and 6 to determine AID. The SID of CP and AA were determined by correcting AID values for basal endogenous AA losses using published values. Chromic oxide (0.3%) was included in the diets as an indigestible marker. The AID (%) of CP (88 vs. 80), Ile (91 vs. 79), Leu (92 vs. 81), Lys (93 vs. 84), Phe (92 vs. 84) and Val (89 vs. 76) for indispensable AA and Asp (91 vs. 81), Glu (94 vs. 87) and Ser (89 vs. 78) for dispensable AA were higher ($P < 0.05$) in PPI than in pea. Similar to AID results, PPI contained higher ($P < 0.05$) SID (%) values than pea for Ile (96 vs. 84), Leu (96 vs. 85), Lys (99 vs. 88) Phe (95 vs. 87), and Val (95 vs. 82) for indispensable AA and Asp (95 vs. 85), Cys (85 vs. 77), Glu (108 vs. 100), and Ser (97 vs. 86) for dispensable AA. The results indicate that PPI has higher AID and SID values for most indispensable AA compared with whole pea.

Key Words: Amino Acid Digestibility, Pea Protein Isolate, Pigs

W142 Growth performance and carcass characteristics of growing pigs fed crude glycerol. P. J. Lammers*[1], M. S. Honeyman[1], B. J. Kerr[2], T. E. Weber[2], and K. Bregendahl[1], [1]*Iowa State University*, *Ames*, [2]*USDA-ARS, Swine Odor and Manure Management Research Unit*, *Ames, IA*.

Growth performance and carcass characteristics of growing pigs fed crude glycerol were determined in a 138-d feeding trial conducted at Iowa State University, Ames, IA. Crude glycerol was obtained from AG Processing Inc., Sergeant Bluff, IA and contained 84.51% glycerol, 12.24% water, 2.93% sodium chloride, and 0.32% methanol. Pigs were weaned at 21d of age and fed a commercial starter-pellet for 1 wk. Eight days post-weaning, 96 pigs (48 gilts, 48 barrows) with an average BW of 8.0 ± 0.2 kg were allotted to 24 pens (4 pigs/pen). Gender distribution and pen weight was balanced at the start of the experiment. Dietary regimes were randomly assigned to each pen, with dietary treatments being 0, 5, and 10% crude glycerol inclusion in corn-soybean meal based diets. Within each phase, diets were offered ad libitum in meal form and formulated to be equal in ME, NaCl, and Lys with other AA balanced on an ideal AA basis. There were 5 dietary phase changes over the 138-d trial. Pigs were weighed once every 2 wk with the change in the dietary phase occurring on a day that all pigs were weighed. Feed disappearance was recorded at the time of pig weighing, and G:F calculated. On d 138, all pigs were weighed (mean BW 133 ± 2.3 kg) and scanned using real-time ultrasound. Least-squares means of growth performance and carcass characteristics were compared using PROC MIXED of SAS. There was no difference in ADG ($P = 0.93$), ADFI ($P = 0.65$), or G:F ($P = 0.13$) among the 3 dietary treatments over the 138 d trial. Dietary treatment did not affect backfat depth ($P = 0.14$), loin muscle area ($P = 0.12$), or percentage fat free lean on a live basis ($P = 0.13$). Pig gender affected backfat depth ($P < 0.001$) and percentage fat free lean on a live basis ($P < 0.001$), but there was no diet by gender interaction for any parameter measured. Growing pigs can be supplemented with up to 10% crude glycerol without affecting growth, efficiency of gain, or carcass composition.

Key Words: Crude Glycerol, Pigs

W143 True phosphorus digestibility of feedstuffs determined with growing and finishing pigs. S. Bunzen, H. S. Rostagno*, L. T. Albino, L. R. Apôlonio, and C. G. Borsatto, *Federal University of Viçosa*, *Viçosa, MG, Brazil*.

The objective of this study was to determine the true phosphorus digestibility coefficients (TPDC) of 18 feedstuffs commonly used in swine diets, including: plant sources, animal by-products and inorganic sources of phosphorus. A complete randomized experimental design was applied in a trial with individual metabolic cages with three replicates per treatment and one pig (barrow) per experimental unit, in a 2 x 2 x 20 factorial arrangement of two methodologies applied simultaneously (Cr2O3 as fecal marker and total fecal collection), two growth phases (Growing with 37.5Kg and finishing with 72.5 Kg) and 18 feedstuffs. Two additional diets were included in the factorial experiment; a reference diet (0.17% P) where the evaluated feed ingredients were included to furnish either 0.15 or 0.20% P, and a low P diet (0,03% P) to estimate fecal P endogenous losses. There was no difference ($P>0.05$) between the two methodologies evaluated (marker 64.5% TPDC vs. total collection 65.8% TPDC). The TPDC of plant feedstuffs was lower ($P<0.05$) when determined with growing pigs as compared to the values obtained with finishing pigs. The TPDC of plant sources for the growing and finishing phases were, respectively: Corn, 54.8 and 81.9%; sorghum, 51.5 and 82.5%; corn gluten feed (22% CP), 33,3 and 49,4%; corn gluten meal (60% CP), 48.6 and 57.8%; cottonseed meal (30% CP), 34.8 and 46.4%; wheat bran & middling, 52.2 and 59.3%; soybean meal, 51,0 and 53,4%; soybean full fat extruded, 44.7 and 66.9% and yeast from alcohol distillery, 62.2 and 70.9%. The TPDC of animal by-products and inorganic sources of phosphorus showed no effect of growing phase ($P>0.05$), with the following average values: meat and bone meal (41% CP), 62.9%; feather and poultry by-products meal, 52.5%; feather meal, 90.8%; fish meal, 88.5%; dried whey, 92.0%; dicalcium phosphate, 66.4%; monocalcium phosphate, 76.1; monodicalcium phosphate, 80.6% and steamed bone meal, 61.8%.

Key Words: Digestible Phosphorus, Feedstuffs, Swine

W144 Effect of phytase on phosphorus and calcium digestibility in lactating sows. J. Tossenberger[1], L. Babinszky*[1], and I. Kühn[2], [1]*University of Kaposvár*, *Kaposvár, Hungary*, [2]*AB Enzymes GmbH*, *Darmstadt, Germany*.

The objective was to determine the effect of dietary phytase supplementation on Ca and P digestibility in lactating sows. The trial used hybrid sows [(Large White x Landrace; average parity: 3.8; 8 sows per treatment (Trt)]. Diets were wheat-barley-soybean meal based and followed NRC energy and amino acid recommendations (1998). Diet in Trt1 had no inorganic P (P_t:3,6 g/kg, Ca:4,3 g/kg) and no phytase supplementation. Dietary P content in Trts2, 3 and 4 was the same as in Trt1, but all were supplemented with phytase (type: 6-phytase produced by *trichoderma reesei*) at a rate of 125 PPU/kg (Trt2), 250 PPU/kg (Trt3) and 500 PPU/kg (Trt4), respectively. Faeces were collected between days 18 and 22 of lactation. Data were analyzed with ANOVA (SAS, 2004). It was concluded based on the results that the feed intake of negative control sows was significantly below ($P \leq 0.05$) the feed intake of animals fed the phytase supplemented diets. Apparent P digestibility was found to be unusually low in contrast to the relatively high values generally described for wheat-barley based diets. This is probably attributable to the low P intake due to low dietary P levels, and to the high endogenous P-portion of the total faecal P excretion. Each of the tested phytase dosages (125 PPU/kg; 250 PPU/kg; 500 PPU/kg) resulted in a further significant ($P \leq 0.05$) increase of P digestibility (Trt1: 22.3%, Trt2: 29.9%, Trt3: 33.5%, Trt4: 36.1%). The expected maximum of P digestibility can not be estimated on the basis of phytase dosages tested. As a result of the lowest phytase dosage (125 PPU/kg) Ca digestibility increased significantly ($P \leq 0.05$). Further increase of the phytase dosages (250 and 500 PPU/kg Phytase) were not accompanied by a further increase of dietary Ca digestibility ($P \geq 0.05$). Supplementation of the wheat-barley-soybean meal based diet of lactating sows (without P_i supplementation) with 100 PPU/kg of this 6-phytase, is expected to increase the P digestibility by 2.6% (R^2: 0.84).

Key Words: Lactating Sow, Phosphorus Digestibility, Phytase

W145 Effect of dietary fat and restriction on productivity and fatty acid composition of Iberian pigs. J. Viguera*[1], M. Señorón[2], M. Cortés[3], J. Peinado[1], J. Ruiz[3], and P. Medel[1], [1]*Imasde Agropecuaria, S.L.*, *Pozuelo de Alarcón, Spain*, [2]*SAT Villa Vieja*, *Olivenza, Spain*, [3]*Universidad de Extremadura*, *Cáceres, Spain*.

A total of 160 Iberian x Duroc pigs (50% male, 50% female, all castrated) of 40.3±2.7kg of initial BW was used to study the influence of dietary fat source and feed restriction on productivity and subcutaneous fatty acid composition. There were 3 experimental periods; i) grower: 40–80kg BW, 98d of trial, common diets *ad lib*; ii) fattening: 80–114kg BW, four treatments arranged as a 2x2 factorial design: *ad lib* (31d) *vs* restricted (51d), diets containing Iberian lard –IL– *vs* oleic acid enriched sunflower oil –OESO– and iii) finisher: 114kg–slaughter, 77d, diets based on IL or OESO *ad lib*. Final BW and experiment duration were 167.4 *vs* 171.5 kg, and 206 *vs* 226 d, for pigs fed *ad lib* and restricted, respectively. The oleic levels were 1.72, 2.65, 2.55 and 3.75% for IL and OESO diets in the fattening and finisher periods, respectively. Each treatment was replicated four times (ten pigs housed together). Productivity was measured per pen every 28d, and biopsies were taken at 98, 129, 149, 207 and 225d for fatty acid analysis. In the grower period, restricted pigs showed lower feed intake, and poorer growth and feed conversion (4,777 *vs* 2,784 g/d, 1,130 *vs* 582 g/d and 4.23 *vs* 4.80 feed/gain, respectively, $P<0.05$). However, in the finisher period, pigs restricted in the grower period had better growth and feed conversion (652 *vs* 778 g/d and 5.94 *vs* 5.23 feed/gain, $P<0.05$) and tended to eat more (3,868 *vs* 4,054 g/d, $P=0.09$) than pigs fed *ad lib*. For the whole period, restricted pigs in the grower period ate and grew less but showed better feed conversion than pigs fed *ad lib* (614 *vs* 581 g/d, 2,994 *vs* 2,759 g/d and 4.88 *vs* 4.75 feed/gain, respectively; $P<0.05$). In addition, feed restriction slightly decreased oleic acid and increased linoleic acid at 129 and 149d. Fat sources did not modify any performance parameter. However, IL consumption slightly increased palmitic acid at 207d, and decreased linoleic acid at 225d and oleic acid at 149, 207 and 225d. It is concluded that the restriction level tested increased the growth period, but improved feed conversion by 2.7%. Fat sources tested caused slight variations in the fatty acid composition.

Key Words: Iberian Pig, Fat Sources, Restriction

W146 Effect of dietary fat on productivity, fatty acid composition and lipid oxidation in Iberian pigs. J. Viguera*[1], M. Señorón[2], M. Cortés[3], J. Peinado[1], and J. Ruiz[3], [1]*Imasde Agropecuaria, S.L.*, *Pozuelo de Alarcón, Spain*, [2]*SAT Villa Vieja*, *Olivenza, Spain*, [3]*Universidad de Extremadura*, *Cáceres, Spain*.

A total of 160 Iberian x Duroc pigs (50% males and 50% females, all castrated) of 35.8±1.3 kg of initial BW was used to study the influence of dietary fat source on productivity, fatty acid composition of intramuscular (IM) fat, and lipid oxidation of pork. A common diet was used from 35 to 110 kg BW. There were four treatments depending on the source of supplemental fat (5 %) from 110 to 170 kg BW: 1) Iberian lard –LARD–, 2) oleic acid enriched sunflower oil –OESO–, 3) olive fatty acid distillers –OFAD– and, 4) olive oleins –OLEI–. The oleic acid levels of the diets were 2.56, 3.77, 3.60, 3.81% for treatments 1 to 4, respectively. Each treatment was replicated four times (ten pigs housed together). After slaughter, samples of the *longissimus* muscle of the last rib of two pigs selected at random per replicate were obtained to quantify the fatty acid composition of the neutral (NL) and polar (PL) lipid fractions of IM fat, and 2–thiobarbituric acid reactive substances (TBARS) at 0, 50, 100 and 200 min of induced lipid oxidation. Pigs fed OFAD showed higher final BW and better feed conversion ratio than pigs fed OESO (172.6 *vs* 163.7 kg and 5.51 *vs* 6.14 g feed/g gain respectively; $P<0.05$). In the PL fraction of IM fat, pigs eating OFAD showed higher linoleic acid values than pigs eating diets with OLEI, LARD and OESO (0.77 *vs* 0.61, 0.56 and 0.48 %; $P<0.01$); pigs fed OESO had more oleic acid than those fed LARD (18.7 *vs* 15.8 %; $P<0.05$); and pigs supplemented with OESO and OLEI showed the highest percentage of polyunsaturated fatty acids ($P<0.05$). At 100 and 200 min, meat from pigs fed LARD showed significantly higher levels of TBARS than those fed the others fat sources. It is concluded that fat sources tested in this study did not modify substantially the fatty acid composition of intramuscular fat. However, diets supplemented with vegetable fats reduced the lipid oxidation of pork loin, probably due to the presence of compounds with antioxidant activity.

Key Words: Intramuscular Fatty Acids, Iberian Pig, Fat Sources

W147 Effect of lignocellulose intake on the ileal endogenous amino acid losses in growing pigs. L. Babinszky*, J. Tossenberger, and J. Tenke, *University of Kaposvár*, *Kaposvár, Hungary*.

Lignocellulose based fiber (LCF) ingredients are increasingly used in pig diets. We studied the changes of ileal endogenous nitrogen (EN) and amino acid (EAA) excretion in response to the LCF supplementation of N-free diets. A total of 12 hybrid barrows were used in the trial (4 treatments, 3 per treatment, 2 replicates, live weight 30±3 kg). Prior to the trials pigs were fitted with a PVTC cannula. The rate of ileal EN and EAA excretion was measured in a total of 4 treatments where N-free diets contained 20-, 36-, 52 and 68 g/kg LCF. Daily rations of the N-free diet contained 2 times the maintenance energy requirement (920 KJ ME/kg$^{0.75}$/d). Diet specification and the DM, CP and AA content of the digesta were determined in accordance with AOAC (1996). Water holding capacity (WHC) of the diets was determined according to Robertson and Eastwood (1981). Trial data were analyzed with ANOVA and regression analysis (SAS, 2004). Our data show a difference of only 18.3 % between the EN excretion of pigs consuming the lowest (20g/kg) and the highest (68g/kg) level of LCF in their diet. The decrease was found to be the largest with MET (21 vs. 11 mg/100 g DMI), THR (81 vs. 52 mg/100 g DMI), TRP (14 vs. 9 mg/100 g DMI). The decrease of LYS excretion was 27.5 % (58 vs. 42 mg/100 g DMI). The probable cause of decrease is the higher WHC due to the increasing dietary LCF level (data not shown). A close linear relationship ($R^2 = 0.99$) was found between the dosages of LCF and the EN excretion of growing pigs. Similarly to the findings for N-excretion a close linear relationship ($R^2 = 0.9 – 0.99$) was found between the dietary LCF content and the rate of ileal EAA excretion. Our data underline that in the calculation of true amino acid digestibility of pig diets no uniform adjustment should be applied to the rate of ileal EN and EAA excretion, and in addition to the crude fiber and NDF content of the diets also the fiber source and its WHC should be taken into account.

Key Words: Lignocellulose, Endogenous Amino Acids, Pigs

W148 The effect of wheat dried distillers grains plus solubles in diets for fattening pigs with or without xylanase. K. Sigfridson and A.-K. Haraldsson*, *Lantmännen*, *Lidköping, Sweden*.

The ethanol production from wheat is growing in Sweden and the volumes of DDGS will increase. Two feeding experiments were performed in order to evaluate wheat DDGS for pigs and the effect of xylanase on a DDGS based diet. Exp 1 comprised of 3 diets, formulated with 0% (control), 10 % and 20% DDGS. Each diet was fed to18 pens (2 pigs/pen). In exp 2 diets with 0% (control), 20% DDGS and 20% DDGS + 200 FXU endo-1,4-beta-xylanase (Ronozyme WX) were fed to 12 pens/treatment (4 pigs/pen). The control diets were based on wheat, barley, RSM, SBM and peas. All diets had a calculated energy value of 12.4 MJ ME/kg and 15% CP. The standardized ileal digestible lysine was 7,7 g (8,5-8,9 g total) and 7,1 g (8,0-8,2 total) per kg for exp 1 and 2, respectively. The pigs were fed each diet from 22 to 110 kg LW, close to ad libitum before 60 kg and restricted after 60 kg LW (34 MJ/d). Data was analysed as least square means (PROC GLM, SAS). At 20% DDGS inclusion level the diets were to 90-95% based on wheat products and barley. To compensate for the decrease in protein quality, the use of pure lysine, threonine and methionine were increased by over 100% in the experimental diets compared to the control. In exp 1, pigs fed the control diet had a DWG of 897g/d, a FCR of 33,6 MJ/kg and 58,2% lean meat content (carcass quality). The DDGS diets did not significantly influence any of these parameters. In exp 2, the performance of the control diet was similar to exp 1, but the DWG and FCR were significantly ($p<0,05$) lower for the diets with 20% DDGS (-4%). Since wheat DDGS is rich in low digestible carbohydrates, the addition of xylanse was thought to improve the DDGS based diet, but no such effect could be proven. It can be concluded that wheat DDGS can be used to fattening pigs, but the inconsistent results from these experiments indicate that variation in the nutritional value of the product can have a significant negative effect on pig performance. Thus, it is of great importance that producers of DDGS provide a consistent product and that the knowledge of energy content and protein digestibility is improved.

Key Words: Wheat DDGS, Fattening Pigs, Xylanase

W149 Isolation and characterization of Bacillus sp. PPS-52 producing thermophilic protease. S. J. Lim and D.-K. Kang*, *Dankook University*, *Cheonan, Choongnam-do, Rep. of Korea*.

Protease enzyme enhances the nutritional value of animal feeds. A thermophilic bacterium PPS-52 showing proteolytic activity against both skim milk powder and defatted soybean was isolated from pig feces. The isolate was found to be the Gram-positive, non-motile, catalase-positive, and spore forming strain. Under an electron microscope, the cells were observed to be rod-shaped. The 16S rDNA sequences of the isolate PPS-52 showed high homology (99%) with that of Bacillus amyloliquefaciens, examined by similarity search using the GenBank database, thus named Bacillus amyloliquefaciens PPS-52. The purification and characterization of the thermophilic protease are under way.

Key Words: Thermophilic Protease, Bacillus

W150 Comparison of the digestible energy content of corn and triticale when fed to finishing pigs. C. Feoli*, J. D. Hancock, C. R. Monge, and T. L. Gugle, *Kansas State University*, *Manhattan*.

A total of 96 finishing pigs (average initial BW of 91 kg) was used in a 5-d experiment to determine the DE content of corn and triticale. The diets were either corn- or triticale-based with added vitamins, minerals, and amino acids. The result was diets with 97.5% corn and 97.8% triticale. Pigs used in the experiment were sorted by sex and ancestry, blocked by BW, and assigned with 12 pigs/pen and four pens/treatment. Feed (meal form) and water were consumed on an ad libitum basis. The pigs were allowed to adjust to the experimental diets for 4 d. Feces were collected from no less than six pigs per pen (via rectal massage) on the afternoon of the fourth day and morning of the fifth day. The fecal samples were dried, ground, and analyzed for concentrations of DM, N, and GE with Cr2O3 used as an indigestible marker. Digestibility of DM was greater ($P < 0.03$) for pigs fed corn vs. triticale (82.8 vs. 81.2%, respectively). However, the opposite was true for digestibility of N ($P < 0.002$) with values of 67.8% for corn and 74.7% for triticale. Digestibility of GE was not different ($P > 0.26$) among the treatments (81.1 and 80.5% for the corn and triticale, respectively). However, because of the greater GE in the triticale, it still had a higher DE content ($P < 0.02$) in triticale with DE value of

3,376 than that of 3,261 kcal/kg in corn. In conclusion, our results indicated that triticale was utilized well by finishing pigs supporting greater digestibility of N and having greater DE than corn.

Key Words: Triticale, DE, Pigs

W151 DXA scans of pig feet accurately predict bone ash content. L. E. Hoffman*, T. Burgers, D. K. Schneider, and T. D. Crenshaw, *University of Wisconsin*, *Madison*.

Dual-energy X-ray absorptiometry (DXA) offers a rapid method to predict bone ash content of humans, animals, and tissues. Earlier work in our laboratory demonstrated that the GE Lunar Prodigy instrument (software version 10.10.038), in selected scan modes, accurately predicted the bone ash content of pigs from 1 to 60 kg. The current experiment was designed to assess the accuracy of DXA scans of pig feet as a rapid screening method to evaluate qualitative responses by pigs to nutrient treatments affecting mineral status. The front foot was selected as an easily accessible sample to collect from carcasses in a slaughter plant. The front foot included all bones distal of the carpal bones. Ten pig feet were aligned parallel to the DXA bed and placed in various orientations to determine which position allowed the most accurate prediction of bone ash content. Orientations included 1) direction of hoof, hoof either scanned first or carpal bones first, 2) dewclaw orientation, dewclaws facing up or down. Another variable included variation in background material, either 2.5 cm or 5 cm thick rice bags, and the position of rice bags, either both beneath the foot or one below and one above the foot. Following scans all bones within each foot were dissected, dried at 100°C for 24 h, and ashed at 750°C for 12 h. Total bone ash content from each foot was compared by regression analysis with bone mineral content (BMC) from DXA scans within each orientation and type of background material. Selection of the regression models to most accurately predict bone ash content from DXA scans were based on the model with a coefficient closest to 1.0. The model selected (ash = -0.403 + 0.988*BMC, R^2=0.979) was based on scans with the hoof scanned first, dewclaws down, and two rice bags beneath the foot. The model with the lowest coefficient (ash = 11.6 +0.717*BMC, R^2=0.836) was based on scans with hoofs scanned last, dewclaws up and one rice bag. In conclusion, DXA scans of pig feet can accurately predict bone ash content of the foot, but foot orientation and background material are important variables.

Key Words: Bone Ash, DXA, Pig Feet

W152 Short-term excesses of potassium bicarbonate for prevention of fatigue in market pigs. J. R. Danielson*, J. L. Reichert, J. A. Kane, and T. D. Crenshaw, *University of Wisconsin*, *Madison*.

The objective of this study was to determine the efficacy of excess cations for prevention of acidosis in market pigs following a brief period of aggressive handling. Thirty two pigs (~115 kg) were used in two replicate trials (16/trial). Pigs were allowed access to either alkaline (ALK, 30.2 g $KHCO_3$/liter) or water (W) treatments via a nipple waterer. Following a 24-h water restriction, pigs were allowed access to ALK or W treatments for 18 h. Pigs were housed 4/pen and allowed ad libitum access to a standard diet. Handling protocols, gentle (GE) or aggressive (AG) were applied to randomly selected pigs within each pen. Total distance for each handling protocol was ~ 960 ft. For AG pigs, handling involved movement through a restricted chute (5 times) with intentional crowding and application of shocks with an electrical prod. The GE pigs were walked the same distance and passed through a restricted chute (5 times) with only a hurdle board used to guide the pigs. In the first trial, 2 pigs from each pen were assigned to GE and AG treatments. In the second trial, 1 pig from each pen was GE and 3 were AG handled (in order to obtain more AG observations). Immediately after completion of handling treatments, venous blood was collected in 10 mL heaprinized vacutainer tubes for blood gas, NH_4 and lactate assays. Blood gas values (SBE, standard base excess, pH, HCO_3) were reduced ($P<0.05$) in AG vs GE pigs, but NH_4 and lactate concentrations were increased ($P<0.05$), consistent with acidosis following AG handling. Differences in blood gas values were not detected ($P>0.10$) between ALK and W treatments within handling protocols. However, in AG pigs given ALK, plasma NH_4 concentrations were greater ($P<0.05$) than pigs given W. Likewise, plasma lactate in ALK pigs tended ($P<0.10$) to be higher than W pigs after AG handling. Conclusions from these data are compromised by measurements obtained from a single time point following AG handling. More frequent sampling intervals are needed to assess the changes in acidosis with ALK treatments after AG handling.

Key Words: Fatigue, Acidosis, Potassium

W153 Effects of dietary supplemental Megazone® on growth performance, nutrients digestibility, blood characteristics, meat quality and carcass traits in weaning-to-finishing pigs. Y. H. Kim*[1], Y. Wang[2], J. C. Park[1], H. J. Jung[1], J. H. Cho[2], Y. J. Chen[2], J. S Yoo[2], I. C. Kim[1], S. J. Lee[1], H. K. Moon[1], and I. H. Kim[2], [1]*National Livestock Research Institute*, *Cheonan, Chungnam, Republic of Korea*, [2]*Dankook University*, *Cheonan, Chungnam, Republic of Korea*.

This study was conducted to investigate the effects of Megazone® (an alumninosilicate mineral mix, which include 30% quartz, 30% feldspar, 30% ceramic and 10% biotite) supplementation on growth performance, nutrients digestibility, blood characteristics, meat quality and carcass traits in weaning-to-finishing pigs. A total of 48 crossbred ([Landrace×Yorkshire]×Duroc) pigs with initial BW of 4.46 ± 0.18 kg were used in a 21 wks trial. Pigs were randomized allocated to two dietary treatments. There were 6 pens per treatment and 4 pigs per pen. Dietary treatments included: 1) CON (basal diet) and 2) MT (basal diet + 0.8% Megazone®). Through the entire experimental period, there were no effects of dietary Megazone® supplementation on growth performance, nutrients digestibility, blood characteristics and meat quality ($P>0.05$). Also, market weight and backfat thickness had no differences between the two treatments ($P>0.05$). However, carcass weight and carcass ratio in MT treatment were improved compared with CON treatment ($P<0.05$). In conclusion, supplmentation of Megazone® can increase carcass weight and carcass ratio in weaning-to-finishing pigs, however, it has no effects on growth performance, nutrients digestibility, blood characteristics and meat quality traits.

Key Words: Megazone®, Alumninosilicate, Digestibility

W154 Pharmacological addition of zinc to diets inhibits phytase activity but does not compromise inorganic phosphorus (iP) retention in young growing pigs. K. M. Retallick*, M. T. Repinski, J. L. Reichert, J. R. Danielson, D. K. Schneider, and T. D. Crenshaw, *University of Wisconsin*, *Madison*.

Pharmacological Zn addition interferes with apparent P retention in pigs fed diets formulated with phytase. Whether Zn directly inhibits phytase or simply inhibits availability of P is not clear. Hypothetically, bone mineral accumulation is compromised in growing pigs by adding Zn to diets with phytase. Forty eight crossbred (PIC Cambrough X Line 19) pigs (initial BW = 9.1+0.10 kg) were randomly allotted within gender and weight blocks to one of eight diets. Pigs were individually fed assigned diets for 56 d. Pig weights and feed consumptions were recorded weekly. Pigs were scanned by dual-energy X-ray absorptiometry (DXA) using a GE Lunar Prodigy (software version 10.10.038). Total bone mineral (BMC, g) and Ca and P retentions were based on differences between individual pig scans at 56 d and predicted BMC on d 0. BMC on d 0 was predicted from earlier trials as BMC = 24.1+14.1*BW, R^2=0.92. Experimental design of dietary treatments involved a slope ratio comparison of iP (0, 0.12 and 0.24% added iP) and phytase (Natuphos to provide 200, 400, and 600 FTU/kg diet) additions to a basal diet. Two diets included ZnO (2000 mg/kg) additions to mid-point levels of each group, 0.12% iP and 400 FTU. Dose response relationships in BMC gain (g/d) were detected (P<0.05) in pigs fed iP or phytase diets. Added Zn reduced (P<0.01) BMC gain in pigs fed diets with phytase, but not iP. Ca and P retention was calculated from BMC gain, assuming a constant Ca (38%) and P (18%) content in bone ash and a constant distribution of total body Ca (96%) and P (80%) within skeletal tissue. Pigs fed diets with iP retained (P<0.05) more P than pigs fed equivalent diets with phytase, even though BW gain was not different (P>0.20). Thus, assumed P equivalency values for phytase did not meet expectations. P retention in pigs fed added Zn was reduced if fed 400 FTU/kg diets, but not if fed diets with 0.12% iP. Added Zn reduced (P<0.05) efficiency of P retention in pigs fed phytase (24% vs 33%), but not iP (34% vs 33%). In summary, Zn interferes with phytase activity, but not iP bioavailability.

Key Words: Efficiency, Mineral Accretion, Phosphate

W155 Effects of dietary supplementation of ginseng by-product on growth performance and pork quality parameters in finishing pigs. J. C. Park*, Y. H. Kim, H. J. Jung, S. D. Lee, H. D. Jang, I. C. Kim, S. J. Lee, and H. K. Moon, *National Livestock Research Institute*, *Cheonan, Chungnam, Republic of Korea*.

The objective of the present study was to investigate the effects of dietary supplementation of ginseng by-product on growth performance and meat quality in finishing pigs. The animals used in the experiment were a total of 24 Landrace × Yorkshire and the average weight was 65.81±2.02 kg. The experimental diets were basal diet (CON) and supplemented diet with 2.5% ginseng by-product (GBP) which replaced lupin in the basal diet. The diets were fed for 60 days. The pigs were divided into three replicates of four pigs in each treatment according to completely randomized design. In growth performance, average daily feed intake was lower (P<0.01) in GBP than in CON. In biochemical composition of plasma, total protein (P<0.05), blood urea nitrogen (P<0.05), glucose (P<0.05), albumin (P<0.05), calcium (P<0.05) and inorganic phosphate (P<0.05) were increased in GBP when compared to CON. Carcass and meat quality were not different between treatments. Total ginsenoside content of meat was higher (P<0.01) in GBP than in CON. TBARs was significantly lower in GBP than in CON for 6 d (P<0.05). The results indicate that dietary supplementation of ginseng by-product affected positively biochemical composition of plasma, total ginsenoside content and TBARs of pork. This study, therefore, suggests that ginseng by-product could be used in the finishing diet of pigs.

Key Words: Ginseng By-Product, Finishing Pigs, Biochemical Composition

W156 Comparative determination of true digestibility and the fecal endogenous calcium losses associated with soybean meal for growing barrows and gilts by the regression analysis technique. Y. Zhang*[1], J. Wang[2], S. Yan[1], Y. L. Yin[3], and M. Z. Fan[4], [1]*Inner Mongolian Agricultural University*, *Huhhot, China*, [2]*The Chinese Academy of Agricultural Sciences*, *Beijing, China*, [3]*Institute of Subtropical Agriculture, the Chinese Academy of Sciences*, *Changsha, China*, [4]*University of Guelph*, *Guelph, Canada*.

Two digestibility experiments were conducted to comparatively determine true digestibility and the fecal gastrointestinal endogenous calcium (Ca) losses associated with conventional solvent-extracted soybean meal (SBM) for growing barrows and gilts. Experiment 1 was conducted with six Yorkshire x Landrace cross-bred barrows with an average initial BW of 28.6±1.8 kg. Experiment 2 was conducted with six Yorkshire x Landrace cross-bred gilts with an average initial BW of 27.6±3.0 kg. Pigs in both experiments were fed six cornstarch-based semi-purified diets containing six levels of total Ca (0.79, 1.19, 1.55, 2.07, 2.38 and 2.81 g/kg DMI) from SBM according to a 6x6 Latin square design for six periods. Chromic oxide (3.5 g/kg diet, on as-fed basis) was included as a digestibility marker. Each experimental period consisted of 8 d with a 6-d adaptation and a 2-d collection of representative fecal samples. There were linear relationships (P<0.05) between the apparent fecal digestible and the total Ca intake in both the barrow and the gilt experiments, indicating true Ca digestibility and the endogenous fecal Ca losses associated with SBM could be measured by the simple linear regression analysis technique. True fecal Ca digestibility (44.3 ± 8.4 vs. 23.4±1.8%, n = 36) and the fecal endogenous Ca loss (1.08 ± 0.01 vs. fecal, 0.43 ± 0.001 g/kg DMI, n = 36) associated with SBM were higher (P<0.01) in the growing barrow than in the gilt. Our results suggest that there are likely differences in true Ca digestibility measured in feed ingredients between barrows and gilts. Barrows may have a high digestive capacity in processing dietary Ca, however, they may have a higher level of Ca requirement for the maintenance due to the larger fecal endogenous Ca loss compared with the gilt.

Key Words: Calcium, Fecal Endogenous Loss, True Digestibility in Pigs

W157 Evaluation of corn grain with the genetically modified event DAS-59122-7 fed to growing-finishing pigs. H. H. Stein*[1], D. W. Rice[2], B. L. Smith[2], M. A. Hinds[2], T. E. Sauber[2], C. Pedersen[3], D. M. Wulf[4], and D. N. Peters[4], [1]*University of Illinois*, *Urbana*, [2]*Pioneer Hi-Bred International Inc.*, *Johnston, IA*, [3]*Danisco Animal Health*, *Marlborough, UK*, [4]*South Dakota State University*, *Brookings*.

An experiment was conducted to assess the nutritional equivalency of corn grain with the genetically modified input trait Cry34/45Ab1 containing the DAS 59122-7 event. This modified transgenic grain is resistant to western corn rootworm and is also tolerant to the herbicide glufosinate-ammonium. The modified grain, a non-transgenic near-isoline control grain, and a commercial hybrid were grown in 2005 in isolated plots (201m apart) at the same location. A total of 108 pigs were allotted to corn-soybean meal diets containing each of the 3 grains as the sole source of corn. Pigs were fed grower diets from 37 to 60 kg, early finisher diets from 60 to 90 kg, and late finisher diets from 90 to 127 kg. Within each phase, data for ADG, ADFI, and G:F were calculated. At the conclusion of the experiment, pigs were harvested at a meat science laboratory and data for carcass quality were collected. Estimate statements were used to compare values from pigs fed diets containing the control corn and pigs fed diets containing the modified corn. Pigs fed diets produced with conventional corn were used as an additional comparator to evaluate the biological significance of any statistical differences. For the entire experimental period, pigs fed the control and the modified corn had similar final BW (128.9 vs. 127.1 kg), ADG (1.02 vs. 1.00 kg per day), ADFI (2.88 vs. 2.80 kg per day), and G:F (0.356 vs. 0.345 kg per kg). Likewise, no differences in dressing percentage (76.48 vs. 76.30%), loin eye area (49.8 vs. 50.4 cm^2), 10^{th} rib back fat (2.20 vs. 2.12 cm) and lean meat (52.9 vs. 53.4%) were observed between pigs fed the control and the modified corn grain. It is concluded that the nutritional value of the modified transgenic corn grain containing event DAS-59122-7 is similar to that of its non-transgenic counterpart.

Key Words: DAS-59122-7, Pigs, Transgenic Corn

W158 Reactive lysine in distillers dried grains and distillers dried grains with solubles measured with the homoarginine or the furosine procedure. A. A. Pahm*[1], C. Pedersen[2], D. Simon[3], and H. H. Stein[1], [1]*University of Illinois*, *Urbana*, [2]*Danisco Animal Nutrition*, *Marlborough, UK*, [3]*South Dakota State University*, *Brookings*.

The objective of this study was to measure the concentration of reactive Lys in 36 samples of distillers dried grains with solubles (DDGS) and in 1 sample of distillers dried grain (DDG) using the homoarginine procedure and the furosine procedure. The standardized ileal digestibility (SID) of Lys in these samples had previously been measured using growing pigs. The homoarginine procedure allows for a direct measurement of reactive Lys by converting all reactive Lys in the sample to homoarginine via guanidination with O-methylisourea. The homoarginine concentration in each sample can then be directly measured. The furosine procedure on the other hand measures the concentration of furosine in each sample, which allows for the calculation of the un-reactive (blocked) Lys in the samples. By subtracting the amount of un-reactive Lys from the total Lys in the sample, the concentration of reactive Lys is calculated. Results of the experiment showed that the concentration of reactive Lys was 74.5% of the total Lys in the samples if the homoarginine procedure was used and 82.5% if the furosine procedure was used. Therefore, the amount of un-reactive Lys in the samples was calculated as 25.5 and 17.5%, respectively, by the homoarginine and the furosine procedures. This indicates that a relatively large proportion of the Lys in DDGS and DDG has been heat-damaged during drying of the samples. The values for reactive Lys were correlated with the concentrations of SID Lys in the samples. The results of these analyses indicated that reactive Lys measured by the homoarginine procedure or the furosine procedure was correlated with SID Lys with reasonable accuracy (r^2 = 0.69 and 0.65, respectively; $P \leq 0.01$). It is concluded that some of the Lys in DDGS and DDG is un-reactive and that the concentrations of un-reactive and reactive Lys in the samples may be measured using either the homoarginine or the furosine procedure.

Key Words: Furosine, Homoarginine, Reactive Lys

W159 Ensilage of the high moisture sorghum related to the endosperm structure and starch granules. A. B. R. C. Lopes*[1], D. A. Berto[1], M. Cereda[2], M. Leonel[2], and C. Costa[1], [1]*FMVZ/UNESP*, *Botucatu, SP, Brazil*, [2]*Cerat/FCA/UNESP*, *Botucatu, SP, Brazil*, [3]*FAPESP*, *São Paulo, SP, Brazil*.

The high moisture sorghum grains, naturally moist or reconstituted grains, offers advantages if compared to dry grains, as it deactivates the tannin and improves the protein digestibility. Thus, positive results were obtained in studies that employed the sorghum silage for poultry and piglets. The storage of grains picked with high moisture under anaerobiosis conditions can be a more practical solution, if compared to the dry grains. The silage offers reduced production costs and presents agronomical advantages, such as early harvest (about three to four weeks in advance), enabling a more effective utilization of the harvesting machines, thus leaving the area free for other cultivations, reduced contamination and losses in the field (stratification, insects and fungi) and in the harvest process, reduced qualitative and quantitative losses of grains attacked by worms and moths in the storage area, better digestibility and animal performance. The purpose of this study was to evaluate the ensilage effects of high moisture sorghum grains on the silo temperature, quality parameters and the changes in the endosperm and starch granules. The treatments were studied: dry grinded sorghum (low tannin); dry grinded sorghum (high tannin); high moisture grinded and ensilaged sorghum (low tannin); high moisture grinded and ensilaged sorghum (high tannin). The values of pH silages varied between 3.80 to 4.0. The high moisture grain ensilage and chemical preservation determined a reduction of the starch contents, if compared to the dry sorghum. During the ensilage process, there was a rupture of the proteic matrix (that involves the starch granules), and structural alterations, such as the increase of the pore diameters, similar to that occurring in the enzymatic digestion.

Key Words: Starch, Temperature Monitoring, Silage of High Moisture Grains

W160 Effect of weaning age on nursery pig growth performance. B. E. Bass*, C. L. Bradley, Z. B. Johnson, J. W. Frank, and C. V. Maxwell, *University of Arkansas*, *Fayetteville*.

Two studies were performed to determine the effect of weaning age on pig performance in the nursery. Feed intake and BW were recorded at the end of each phase. Initial BW was used as a covariate in the data analysis. In experiment 1, 270 pigs [GPK348 × EB and (GPK348 × GPK4) × EB] were weaned at an average of 18.2 d of age (BW = 6.42 kg) or 20.8 d of age (BW = 6.48 kg) and housed 9 pigs/pen in a wean-to-finish facility. Pigs were fed common Phase 1 (d 0 to 13) and Phase 2 (d 13 to 34) diets. There were no differences in BW, ADG, ADFI, or G:F with weaning age in the wean-to-finish facility.

In experiment 2, 252 pigs (GPK35 × EBX) were weaned at an average of 19.0 d of age (BW = 5.91 kg) or 21.8 d of age (BW = 6.55 kg) and housed 6 pigs/pen in an offsite nursery. Pigs were fed common Phase 1 (d 0 to 13), Phase 2 (d 13 to 28), and Phase 3 (d 28 to 41) diets. Pigs weaned at 21.8 d of age were heavier than pigs weaned at 19.0 d of age at the end of Phase 1 (10.15 vs. 9.83 kg), Phase 2 (19.23 vs. 18.52 kg), and Phase 3 (28.95 vs. 27.77 kg) ($P < 0.05$). Additionally, ADG was greater for pigs weaned at 21.8 d during Phase 1 (302 vs. 277 g/d), Phase 2 (606 vs. 578 g/d), Phase 3 (748 vs. 710 g/d), and over the entire nursery period (554 vs. 525 g/d) ($P < 0.05$). Pigs weaned at 21.8 d of age also had greater ADFI than those weaned at 19.0 d of age during Phase 1 (379 vs. 351 g/d), Phase 2 (996 vs. 927 g/d), Phase 3 (1422 vs. 1315 g/d), and over the entire nursery period (936 vs. 867 g/d) ($P < 0.05$). There were no differences in G:F between the two weaning groups. Results of this study indicate that differences exist in performance due to weaning age when pigs are weaned into an offsite nursery, with pigs weaned at 21.8 d of age having improved overall growth performance compared to 19.0 d of age. It appears that the increased performance throughout the nursery period in the group weaned at 21.8 d of age can be attributed to increased feed intake, and not improved feed efficiency.

Key Words: Pigs, Weaning Age, Growth

W161 The endosperm structure and starch granules to ensilage of high moisture corn grains. A. B. R.C. Lopes*[1], D. A. Berto[1], M. Cereda[2], M. Leonel[1], and C. Costa[1], [1]*Faculdade de Medicina Veterinária e Zootecnia/UNESP*, *Botucatu, SP, Brazil*, [2]*Cerat/FCA/UNESP*, *Botucatu, SP, Brazil*.

In order to evaluate the effects of high moisture corn grains silage related to the product's final quality and the modifications in the endosperm and starch grains, the following treatments were studied: The following types of treatment were studied (T): T1- Dry whole corn; T2- Dry grinded corn; T3- High moisture grinded and ensiled corn. The high moisture corn grains were grinded at a mill using a 6-mm sieve, while the dry corn was triturated using a 2mm sieve. The silages were stored in 100-liter plastic silos. The temperature monitoring inside four silos of each type of treatment was performed using copper-constantan thermocouples (T type) of PVC insulation and 2X24 AWG, coupled to a data acquisition system equipped with own software, programmed to perform readings at regular intervals of 10 seconds. The temperatures were stored, and the system produced an average value each two hours, also recording the ambient temperature of the places where the silos where located. The samples of dry grains and high moisture ensiled grains were collected and immediately submitted to the pH, granulometry and moisture analyses. The determination of the total starch content followed the methodology of the International Norm ISO 6647. Analyses in scanning microscope were conducted to evaluate the endosperm and the starch granule structures, at the laboratory of the Electronic Microscopy Center of UNESP Biosciences Institute, in Botucatu. The high moisture grain ensilage determines a reduction of the starch contents, if compared to the dry corn. There were some changes during the ensilage process: the rupture of the proteoleic matrix (that involves the starch granules), and structural alterations, such as the increase of the pore diameters and the central concavity, similar to that occurring in the enzymatic digestion.

Key Words: Starch, Temperature Monitoring, High Moisture Grains

W162 Effects of feeding alfalfa on nursery pig growth performance. C. L. Martin*[1], J. W. Frank[1], Z. B. Johnson[1], G. M. Weiss[2], and C. V. Maxwell[1], [1]*University of Arkansas*, *Fayetteville*, [2]*Progress Plus LCC*, *Lancaster, WI*.

Two experiments were conducted to determine the effects of feeding high quality, low fiber alfalfa on growth performance during the nursery period. Typical nursery diets were fed in three phases. Diets in each phase consisted of 0, 5, or 10% alfalfa. A late fall cutting of alfalfa leaves and stems were used in experiment 1 and alfalfa leaves were used in experiment 2. Diets were fed from d 0 to 42 after weaning [Phase 1 (d 0-14), Phase 2 (d 15-28), and Phase 3 (d 29-42)]. In experiment 1, 270 pigs (initial BW = 6.65 ± 0.01 kg) were blocked by BW and randomly allotted to one of the three treatments and reared in a wean-to-finish facility (9 pigs/pen). In Phase 1 and 2, ADG decreased quadratically with increasing alfalfa level ($P = 0.03$). There were no significant differences in growth performance during Phase 3. Overall, ADG (0.493, 0.506, 0.474 kg/d; respectively, $P = 0.02$) and final BW (26.92, 27.38, 26.09 kg/d; respectively, $P < 0.02$) increased quadratically with increasing level of alfalfa. In experiment 2, 234 pigs (initial BW = 6.23 ± 0.01 kg) were blocked by BW and randomly allotted to one of three treatments and reared in a conventional nursery (6 pigs/pen). In Phase 1, ADG, ADFI, G:F and BW decreased linearly with increasing level of alfalfa ($P < 0.03$). During Phase 2, ADG, ADFI, and BW decreased quadratically with increasing level of alfalfa ($P < 0.03$). There were no significant differences in growth performance during Phase 3. Overall, ADG (0.437, 0.425, 0.391 kg/d; respectively) ADFI (0.647, 0.642, 0.601 kg/d; respectively) and BW (24.29, 23.96, 22.59 kg; respectively) decreased linearly with increasing level of alfalfa ($P < 0.01$). In summary, feeding greater than 5% alfalfa during Phase 1 and 2 to pigs during the nursery period may decrease average daily gain and body weight. However, Phase 3 nursery diets containing 10% alfalfa had no effect on growth performance.

Key Words: Pigs, Alfalfa, Growth

W163 Effect of *Ascophyllum nodosum* extract on growth performance, nutrient digestibility, carcass characteristics and selected intestinal microflora populations of grower-finisher pigs. G. E. Gardiner[1,2], A. J. Campbell[1,3], J. V. O'Doherty[3], E. Pierce[3], P. B. Lynch[1], F. C. Leonard[3], C. Stanton[1,2], R. P. Ross[1,2], and P. G. Lawlor*[1], [1]*Teagasc, Moorepark Research Centre*, *Fermoy, Co. Cork, Ireland*, [2]*Alimentary Pharmabiotic Centre*, *Cork, Ireland*, [3]*University College Dublin*, *Belfield, Dublin, Ireland*.

Two experiments were conducted to assess the effect of dietary supplementation with increasing levels of *Ascophyllum nodosum* extract (ANE) on growth performance, carcass characteristics, diet digestibility and gastrointestinal microflora of grow-finisher pigs. In experiment 1, 360 pigs were allocated, based on live-weight and sex, to one of four treatments as follows; control diet (no ANE), control diet plus 3 g/kg ANE, control diet plus 6 g/kg ANE and control diet plus 9 g/kg ANE. These diets were fed *ad-libitum* up to slaughter. At slaughter, ileal, caecal, colonic and rectal digesta as well as ileum and colon tissue were sampled from eight animals per group for microbiological analysis. In experiment 2, eight male pigs were allocated to a control diet (no ANE) or the control diet plus 2.5 g/kg ANE to determine effects of ANE on coefficient of total tract apparent digestibility (CTTAD) of nutrients and nitrogen (N) balance. Supplementation with increasing levels of ANE resulted in reduced

daily gain, carcass weight and kill-out yield during the combined grower-finisher period (P<0.05); however, there were no effects of treatment on feed intake, feed conversion ratio or carcass characteristics. Increasing levels of dietary ANE resulted in decreased ileal coliform counts (P<0.05). Increasing dietary ANE levels tended to increase adherent lactobacilli in the colon (P=0.08) but caecal bifidobacteria declined (P<0.05) and there were trends towards a linear reduction in colonic bifidobacteria (P=0.08) and towards a quadratic effect on rectal lactobacilli (P=0.08). Intestinal pH was unaffected by ANE supplementation (P>0.05). In experiment 2, the CTTAD of nutrients was unaffected by the inclusion of ANE (P>0.05). Overall, the intestinal coliform reductions obtained suggest that ANE may provide a dietary means to improve gut health in finishing pigs. However, the negative effects on growth performance observed in healthy animals will most likely limit the commercial use of dietary ANE as a feed additive.

Key Words: *Ascophyllum nodosum*, Intestinal Microflora, Pig

W164 Effects of energy and lysine intake during late gestation and lactation on the lactational performance in multiparous sows. S. Heo, Y. X. Yang, Z. Jin, J. H. Yun, J. Y. Choi, B. K. Yang, and B. J. Chae*, *Kangwon National University*, *Chuncheon, Kangwon-Do, Republic of Korea*.

A 3 × 2 factorial experiment was conducted to evaluate different dietary levels of energy and lysine during late gestation and lactaion period on reproductive performance in multiparous sows. A total of 36 sows (Yorkshire × Landrace, 3-4 parity) were divided into 6 treatments and each treatment had 6 replicates comprising 1 sow/pen. Treatments consisted of three energy levels (3,265, 3,330, 3,400 ME/kg) and two lysine levels (0.6, 0.8%) during late gestation (from 80th day) and three energy levels (3,265, 3,330, 3,400 ME/kg) and two lysine levels (1.0, 1.3%) during lactation, respectively. The experiment started at 80th day of gestation and the lactational period lasted for 25 days. The higher lysine group significantly affected body weight change (p<0.05) and backfat thickness change (p<0.001) of multiparous sows during both late gestation and lactation. Average daily feed intake was not affected (p>0.05) by either energy or lysine in the diets. During lactation, live birth weight/litter (p<0.01), weanling weight/litter (p<0.01) and growth rate of piglets (p<0.05) were increased as lysine intake was increased. No difference was found piglet's growth performance by dietary energy levels. Wean-to-estrus interval was reduced (p<0.001) in the high lysine group. In conclusion, higher lysine levels than those suggested by NRC (1998) improved body condition and reproductive performance during late gestation and lactation in multiparous sows.

Key Words: Multiparous Sows, Energy, Lysine

W165 Effects of dietary energy and lysine levels during late gestation and lactation on the lactational performance in primiparous sows. S. Heo, Y. X. Yang, Z. Jin, J. H. Yun, J. Y. Choi, B. K. Yang, and B. J. Chae*, *Kangwon National University*, *Chuncheon, Kangwon-Do, Republic of Korea*.

The effects of energy and lysine intake during late gestation and lactation on reproductive performance of primiparous sows were evaluated using 36 gilts (Yorkshire × Landrace). The sows were allocated to six dietary treatments according to a 3 × 2 factorial arrangement and each treatment had 6 replicates comprising 1 sow/pen. Treatments consisted of three energy levels (3,265, 3,330, 3,400 ME/kg) and two lysine levels (0.6, 0.8%) during late gestation (from 80th day) and three energy levels (3,265, 3,330, 3,400 ME/kg) and two lysine levels (1.0, 1.3%) during lactation (25 days), respectively. Gilts fed the high lysine diet gained more weight (p<0.01) and higher backfat thickness (p<0.05) than those fed the low lysine diets. A same trend was shown during lactation. Average daily feed intake was not affected (p>0.05) by either energy or lysine. Birth weight (p<0.001), weanling weight (p<0.001) and growth rate of piglets (p<0.001) were increased as lysine intake increased during lactation. High dietary lysine levels during lactation decreased wean-to-estrus interval (p<0.01). From the present study, it can be concluded that higher lysine levels than those recommended by NRC (1998) could improve the reproductive performance during late gestation and lactation in primiparous sows.

Key Words: Primiparous Sows, Energy, Lysine

W166 Effect of GnRH-analogue and chromium methionine supplementation on reproductive performance of the female pig. J. A. Romo*[1], R. Barajas[1], J. J. Valencia[2], E. Silva[3], and F. Juarez[1], [1]*FMVZ-Universidad Autonoma de Sinaloa*, *Culiacan, Sinaloa, Mexico*, [2]*FMVZ-Universidad Nacional Autonoma de Mexico*, *Mexico, D.F., Mexico*, [3]*FMVZ-Universidad de Colima*, *Colima, Colima, Mexico*.

To determine the effect of GnRH-analogue injection (GnRH-A) and chromium methionine (CrMet) supplementation on reproductive performance of young and multiparous sows, two experiments were performed. Experiment 1: One hundred twenty eight hybrid young sows were used, in a randomized experimental design with a factorial arrangement 2 x 2. Young sows were designed for receive: Diets supplemented or not with 0.4 ppm of Cr (Microplex®, Zinpro Co.) during tree subsequent reproductive cycles, and the application or not of 50 µg de GnRH-A (Fertagyl®, Intervet Lab) four days before of the weaned. Chromium addition and GnRH-A application had not effect (P > 0.16) on the litter size and litter weight at time born; however, the farrowing rate at first service after weaning was improvement (P < 0.02) both for Cr or GnRH-A used alone or together (76% vs. 89%). Cr supplementation diminished (P < 0.001) 35% the interval weaning-first oestrus (7.89 vs. 5.11 d), and GnRH-A application diminished (P = 0.02) 25% this variable (7.41 vs. 5.59 d). An interaction (P < 0.05) Cr x GnRH-A was found, where young sows receiving joint Cr and GnRH-A treatments shown the lowers values. Experiment 2: Two hundred thirty nine multiparous hybrid sows were used, to probe the same treatments that experiment 1. Cr addition and GnRH-A application had not effect (P > 0.23) on the litter size, litter weight at time born, and the farrowing rate at first oestrus after weaning of the multiparous sows. Cr supplementation diminished (P < 0.01) the interval weaning-first oestrus (5.36 vs. 4.53 d). An interaction (P = 0.04) Cr x GnRH was observed where sows receiving joint Cr and GnRH-A treatments had higher values than sows that received Cr only. These results suggest that both chromium supplementation and GnRH-A injection are able to improve reproductive performance in both young and mature sows.

Key Words: Chromium, GnRH-A, Sows

W167 Effects of yeast culture supplementation to lactation diet on lactation performance of sows. C. Vasquez*[1], A. T. Moore[1], C. R. Richardson[2], and S. W. Kim[1], [1]*Texas Tech University*, *Lubbock, TX, USA*, [2]*Texas State University*, *San Marcos, TX, USA*.

This study was conducted to determine the effect of yeast culture (Gro-Tec) supplementation to lactation diet on lactation performance of sows. Twenty-four pregnant sows were selected for this study. All pregnant sows were fed the same 2 kg gestation diet (12.2% CP, 3.1 Mcal ME/kg) per day until farrowing. Two sows did not farrow and thus eliminated from the study. Immediately after farrowing, sows were allotted to two dietary treatments (11 sows each). Treatments were: (1) CON (sows fed a corn-soybean meal basal diet during lactation); and (2) GT (sows fed a basal diet with 60 g yeast culture/day, top-dressed). The basal diet contained 19.2% CP and 2.37 Mcal ME/kg. Sows received yeast culture (top-dressed) from d 0 to d 17 of lactation (at weaning) according to their assignment. Within a treatment, litter size was set to 9 pigs by cross-fostering and this was done by 36 h post-farrowing. Sow had access to feed and water ad libitum during 17-d lactation. Voluntary feed intake was measured daily. Sow body weight was measured at d 0 (within 12 h farrowing), 7, 14, and 17 of lactation. Body weight of nursing piglets was also measured at d 0, 7, 14, and 17 of age. Sows weaned the litter at d 17 of lactation and moved back to gestation crates. Number of days-return-to-estrus was measured for each sow. Litter size and litter weight at birth did not differ between the treatment groups. Litter size at weaning did not differ between the treatment groups. However, litter weight gain of GT (18.1 kg) tended to be greater (P=0.052) than that of CON (16.6 kg). Body weight of sows after farrowing did not differ between the treatment groups. Body weight loss during the 17 d lactation period was 11.7 kg for CON and 17.3 kg for YC but there was no statistical difference. Voluntary feed intake of sows and days return-to-estrus did not differ between the treatment groups. This study indicates a possible benefit of yeast culture supplementation on litter weight gain.

Key Words: Yeast Culture, Sow, Litter Weight Gain

W168 Antibiotics, acidifiers or yeast on the productive performance of growing pigs challenged with *Salmonella cholerasuis*. A. A. Martinez*[1], J. Lopez[1], J. N. Vazquez[1], B. Merino[2], G. E. Lanz[2], and J. A. Cuaron[3], [1]*CENID-Microbiologia,INIFAP*, *Mexico*, [2]*PIEPEME, A.C.*, *Mexico*, [3]*CENID-Fisiologia Animal, INIFAP*, *Mexico*.

The effect of different feed additives used as non-antibiotic growth enhancers, under an induced salmonella infection, was studied using 96 pigs with an average BW of 42.18+ 7.02 kg. The animals were randomly assigned to six dietary treatments (given in four 21 days feeding phases): CON: Control (without additives); ATB: Antibiotic, Chlortetracycline (200 ppm) and furazolidone 220 ppm during feeding phase one and Tylosine (110 ppm) during feeding phase three; SC: Live yeast, *Saccharomyces cereviseae*, strain Sc47 at 3 kg/MT; BAC: Benzoic acid 5 kg/ton; COA: a commercial mix of organic acids that included Phosphoric cid, formic acid and lactic acid (2kg/ton); ORE: oregano extract 500 g /ton. During phase 4 no additives were used. Each treatment had 4 replicates with 4 pigs each. Performance was measured during 90d. On days 12 and 16, pigs were challenged orally with $1x10^9$ cfu of *Salmonella cholerasuis*, isolated from a clinical case. ADG decreased from day 12 to 34 post inoculation in all treatment groups, this growth depression was less severe (P<0.01) on pigs receiving BAC. Daily feed intake was similar (P>0.05) among treatments during all the study period. Accumulated ADG was greater (P<0.01) for ATB, SC and BAC (848, 804 and 830g respectively) vs. CON, COA and ORE (760, 760 and 769g respectively). The antibiotics used during phase 1 were specific for the control of Salmonella; in preious studies, SC has shown a great capacity to precipitate pathogenic salmonellae and BAC greatly reduces microbiological counts in feces; acidifying agents or herbal extracts have unspecific effects, thus these results are not surprising and give light to alternative preventive treatments for oral infections.

Key Words: Organic Acids, Yeast, Salmonella

W169 Benzoic acid as feed additive for growing pigs naturally infected with *Salmonella cholerasuis*. A. A. Martinez*[1], J. Lopez[1], B. Merino[2], J. Cervantes[3], and J. A. Cuaron[4], [1]*CENID-Microbiologia, INIFAP*, *Mexico*, [2]*PAIEPEME, A. C.*, *Mexico*, [3]*DSM Nutritional Products*, *Mexico*, [4]*CENID-Fisiologia Animal, INIFAP*, *Mexico*.

A total of 120 pigs were used to evaluate the effects of adding benzoic acid (BZA), alone or in combination with antibiotics, to enhance productive performance of growing-finishing pigs recovering from a natural salmonella infection (*Salmonella cholerasuis*) adquired at site 2 facility. With the appropriate use of antibiotics, the infection was apparently controlled and, twelve days after, pigs were moved (BW=18.9+1.2 kg) to a site 3 facility (day 0), where they were allotted to 6 treatments, from a 2x3 factorial arrangement: BZA (0 or 5 kg/ton); and the use of antibiotics: Control (none added), growth enhancement antibiotic (Virginiamicine, 10ppm) or therapeutic antibiotic for unspecific respiratory diseases (Tylosine, 110 ppm). Each treatment had 4 replicates with 5 pigs per replicate. On d-42 of the experiment, clinical signs of salmonellosis were observed and the presence of *Salmonella spp*., probably carried out from the site 2 facility, was confirmed by bacteriological studies. BZA and the use of antibiotics did not result (P>0.05) in an interaction for any of the response criteria. There were no differences among treatments (P>0.05) on morbidity, but mortality was reduced (P<0.08) after BZA and the therapeutic antibiotic compared with the control (1.2 and 2.4 vs. 6%). Daily feed intake was not affected by Treatments (P>0.05), but BZA and the therapeutic antibiotic improved daily weight gain (P<0.01) during the first 28 days; this response was sustained until day 49 (P<0.06), but later period responses were similar (P>0.24). After 105 days, use of the therapeutic antibiotic during recovery resulted in pigs 7kg heavier (P<0.01) and BZA gave an advantage of 4kg (P<0.06) in the same period, over Control and the antibiotic as a growth enhancer. Tylosine actes to prevent possible respiratory consequences; BZA could be of help in the control of intestinal problems, but apparently it is not a substitute for the therapeutical use of antibiotics.

Key Words: Benzoic Acid, Salmonella, Pigs

W170 Response of grower pigs to dietary inclusion of naked oats (Avena nuda). P. B. Lynch*[1], P. G. Lawlor[1], and J. Burke[2], [1]*Teagasc, Moorepark Research Centre*, *Fermoy, Co. Cork, Ireland*, [2]*Teagasc, Oakpark Research Centre*, *Carlow, Ireland*.

Naked oats (Avena nuda) is a crop with potential agronomic advantages when used in a cereal rotation in Ireland. In contrast to hulled oats

(Avena sativa) naked oats is low in fibre and high in oil and protein. The oats have been fed to pigs with varying degrees of success. The object of this trial was to evaluate naked oats as a direct replacement for wheat in diets for grower pigs in the weight range 14 to 34kg. Single-sex pairs of pigs (n=48) were used in a randomised complete block design with four treatments. The control diet contained (g/kg) barley - 225, wheat - 455, soya bean meal - 180, heat treated soya beans - 100, lysine HCl - 4, DL-methionine - 2, L-threonine - 1.5, minerals and vitamins. The diet contained (calculated values) 14.1 MJ digestible energy, 196g crude protein and 13g total lysine, 5.0g methionine, 3.5g cystine, 8.6 threonine and 2.5g tryptophan. Naked oats replaced wheat at 100, 200 and 300g/kg. The diets were fed ad libitum as 5mm pellets. Daily weight gain was 719, 695, 673 and 694 (NS, s.e. 23.7 g/day), feed conversion ratio (FCR) was 1.52, 1.59, 1.61 and 1.56 (s.e. 0.026) for control, 100, 200 and 300 inclusion levels. The quadratic effect for treatment differences in FCR was significant (P<0.05). It is concluded that naked oats can replace wheat in the diet of young growing pigs at up to 300g/kg.

Key Words: Naked Oats, Grower Pigs

W171 Comparison of growing swine performance when diets containing DL- methionine and cull chickpeas in substitution of soybean meal and corn. J. M. Uriarte*, J. F. Obregón, H. R. Guemez, O. S. Acuña, and F. G. Ríos, *Universidad Autónoma de Sinaloa*, *Culiacán, Sinaloa, México*.

To determinate the effect of substitution of soybean meal and corn for cull chickpeas on growth performance, 48 pigs (BW = 27.475 ± 0.896 kg; Large white x Landrace x Large white x Pietrain) in groups of four were placed in 12 concrete floor pens (2.5 x 2.5 m). Pens were fed one fo three diets: 1) Diet with 17.21 % CP and 3.35 Mcal ME/kg, containing corn 71.0 %, soy bean meal 25 %, and premix 4 % (CONT); 2) Diet with 17.1 % CP and 3.35 Mcal ME/kg with corn 37 %, cull chickpeas 50 %, soybean meal 9 %, and premix 4 % (CHP50) and 3) Diet similar to CHP50 with 0.2 % of DL-methionine additioanated (CHP50M). Pigs were weighed at days 0 and 49 of experiments and feed intake was recorded daily. ADG and feed intake/gain ratio were calculated from these data. Body weigth at day 49 (56.063, 51.688 and 53.125 kg) were not affected (P=0.09) by CONT, CHP50 and CHP50M, respectively. ADG (0.584, 0.429 and 0.525 kg) was not similar (P=0.05) between CONT and CHP50. Feed intake (1.459, 1.441 and 1.472) was not modified (P=0.85) by treatments. Feed/gain ratio (2.506, 2.936, and 2.9811) was different (P=0.01) between CONT with CHP50 and CHP50M treatments. It is concluded, that cull chickpeas additionated with 0.2 % of DL-methionine can be used up 50 % in diets for growing pigs without affecting body weight, average diary gain and feed intake, but increased feed intake/gain ratio.

Key Words: Chickpeas, Growth Performance, Methionine

W172 Use of a selected clay in growing pigs fed zearalenone contaminated sorghum grain. J. Lopez[1], A. A. Martinez*[1], D. V. Gonzalez[1], and J. A. Cuaron[2], [1]*CENID-Microbiologia, INIFAP*, *Mexico*, [2]*CENID Fisiologia Animal, INIFAP*, *Mexico*.

Certain clays are used as feed additives to decrease the effects of mycotoxins. An experiment was conducted to evaluate the use of a selected clay (Mexsil)® on the prevention of growth depression of growing pigs consuming a grain naturally contaminated and with marginal toxic levels of mycotoxins. One hundred an twenty pigs (30.03 kg avg. initial BW), were allotted to 4 dietary treatments, from outcome groups formed by litter of origin, sex and weight, in a Randomized Complete Block design. Treatments were a 2x2 factorial arrangement: level of zearalenone (ZEA) in sorghum (LOW, 21.6 to 41.6 and HIGH, 111.2 to 146.6 mg/ton) and the addition or not of Mexsil®(Control and 5 kg/ton). Performance was measured during 98 days. As the inclusion of sorghum grain in three feeding phases, as well as the daily feed intake increased, the dose (µg/ kg BW) of ZEA received went from 1.66 to 0.91 for the LOW and from 5.87 to 2.98 for HIGH, for the feeding phases 1 to 3. For these reasons, differences in response to the addition of Mexsil®and the level on ZEA were greater during days 0 to 70 of the experiment. No clinical signs of mycotoxicosis were observed. Daily feed intake and feed efficiency were not affected by the level of ZEA (P>0.05), but ADG was lower (P<0.01) for pigs consuming the HIGH level of mycotoxins (755 vs. 837 g). Mexsil® addition improved (P<0.05) ADG (814 vs. 778 g) as was able to maintain gains of pigs consuming ZEA at higher levels. Mexsil® and ZEA did not result in an interaction for any of the response criteria. Use of this clay was effective to improve productive performance of pigs in presence of a subclinical levels of ZEA.

Key Words: Zearalenone, Clay, Pigs

W173 Effects of flaxseed and carbohydrase enzyme on portal blood short chain fatty acids, caecal digesta amine content and tissue fatty acid profiles in piglets. E. Kiarie*, B. A. Slominski, and C. M. Nyachoti, *University of Manitoba*, *Winnipeg, MB, Canada*.

We previously demonstrated that piglets fed flaxseed (FS)-containing diets with or without a multi-carbohydrase enzyme (CE) blend had reduced ileal microbial activity. Further studies were conducted to determine portal venous plasma short chain fatty acids, cecal spermidine, loin and liver fatty acid profiles and fecal fat digestibility. Ninety-six weaned pigs (6.1 kg initial BW) were assigned to 4 diets in a completely randomized design (6 replicate pens of 4 pigs each). Diets consisted of a basal diet containing 0% or 12% FS and were fed with or without CE containing pectinase, cellulase, mannanase, xylanase, glucanase and galactanase activities. Diets were fed for 28 d after which time fresh fecal samples were collected and 1 pig per pen was held under a surgical plane of anesthesia to sample portal blood. Pigs were then killed by an intracardiac injection of sodium pentobarbital (110mg/kg) to sample cecal digesta, liver and loin area tissues (loin muscle plus back fat). Piglets fed FS diets had lower portal acetic acid (0.58 vs. 0.72, mmol/L; P = 0.05) and higher lactic acid (3.17 vs. 2.21, mmol/L; P = 0.04) compared with those fed non-FS diets. In the caecum, FS diets resulted in lower spermidine levels (0.65 vs. 0.98, PPM; P = 0.01) compared with non-FS diets. Flaxseed fed piglets had lower omega-6 to omega-3 fatty acid ratios in the liver and loin area (1.7 vs. 4.1, g/100g; P = 0.0001 and 3.5 vs. 6.6, g/100g; P = 0.0001, respectively) compared to non-FS diets. Pigs fed FS diet had lower (P = 0001) fecal fat digestibility compared with pigs fed non-FS diets. There tended to be an interaction between FS and CE in fat digestibility and tissue omega-3 fat deposition such that in FS fed

piglets CE supplementation resulted in higher fecal fat digestibility and tissue omega-3 fat deposition. In conclusion, feeding FS with or without CE supported lactic acid ferementors in the in the gastrointestinal tract. Although overall low fat digestibility was observed high omega-3 retention in FS fed piglets was evident.

Key Words: Flaxseed, Carbohydrase Enzymes, Piglet

Nonruminant Nutrition: Poultry Nutrition III

W174 Biochemical profile of broilers fed diets supplemented with amylase from *Cryptococcus flavus* and *Aspergillus niger* HM2003. C. S. Minafra[2,1], J. H. Stringhini*[1], S. F. F. Marques[1], M. A. Andrade[1], C. J. Ulhoa[1], and G. H .K. Moraes[2], [1]*Universidade Federal de Goias*, *Goiania, Goias, Brazil*, [2]*Universidade Federal de Viçosa*, *Viçosa, Minas Gerais Brazil*.

In this experiment, the effect of alpha-amylase addition in broler rations on biochemical seru parameters was evaluated. The enzyme were produced by *Cryptococcus flavus* (CF) in Enzymology Laboratory Biological Sciences, (UFG) and by *Aspergillus niger* HM2003 (AN) in the Biotechnology Center (UFRS). 360 day-old male Cobb chicks were allotted in heated batteries in the Veterinary College, (UFG). Enzymes were added in the first week and from eight to 21 days in a completely randomized design with six treatments and five replications of 12 chicks each. Treatments consisted of pre-starter diets without enzyme (RPSS), with CF amylase (RPSCry) and with AN enzyme (RPSAsp), and starter diets without enzyme (RPS), with CF amylase (RSCry) and with AN enzyme (RSAsp). Statistical analyses were done with SAEG 9.1, using Tukey test 10% probability. Blood were collected at seven and 21 days and centrifuged at 6.000 rpm in 10 minutes to obtain serum. Serum analysis of minerals Ca, P, Cl, K, alkaline phosphatase, and protein was done. No effect in concentrations of K and AP were observed at seven days and for Ca, Cl or AP at 21 d. At 7 d, higher concentration of Ca in RPSCry, P in RPSAsp, Cl in PSV and Prot in RPSVAsp. At 21 d, higher concentrations of Ca, Prot and K in RSVAsp. These parameters indicate serum profile of broilers but didn't characterize the effect of enzymes addition in rations.

Table 1. Serum profile of Ca, P, Cl, K, TP and AP for broiler fed diets containing amylase from *Cryptococcus flavus* and *Aspergillus niger* HM2003

7 days	VPS	VPSCry	VPSAsp
Ca (mg/dL)	5.7b	6.9a	6.0ab
P (mmol/L)	5.1b	4.8b	6.2a
Cl (mmol/L)	153a	124b	141ab
K (mmol/L)	6.4a	6.5a	6.12a
TP (g/dL)	1.8b	2.0b	2.5a
AP (UI/L)	970a	980a	975a
21 days	VS	VSCry	VSAsp
Ca (mg/dL)	6.0a	5.5a	5.5a
P (mmol/L)	5.7a	5.0b	5.0b
Cl (mmol/L)	124a	137a	139a
K (mmol/L)	4.5c	5.9b	6.7a
TP (g/dL)	3.6a	3.0b	3.1b
AP (UI/L)	969a	961a	970a

Different letters in the row differ by Tukey test (5%)

Key Words: Biotechnology, Enzymes, Serum Profile

W175 Effects of graded levels of cottonseed cake on performance, haematological and carcass characteristics of broilers fed from day old to 8 weeks of age. G. O. Adeyemo* and O. G. Longe, *University of Ibadan*, *Oyo, Nigeria*.

Cottonseed cake (CSC) has been used as a cheaper alternative to soyabean cake (SBC) in livestock feeding and a source of dietary protein. There is, however, paucity of information on its nutritive value in chickens. This study evaluated the performance, haematological and carcass characteristics of chickens in which CSC replaced SBC in a nutritional experiment. One hundred and eighty day old chicks (DOC) were fed with 5 different diets, such that 0% (control), 25%, 50%, 75% and 100% of CSC replaced SBC from day old to 8 weeks of age. Average weekly gains (AWG), feed conversion ratio (FCR) and dressed weight (DWT) were monitored. Blood samples were collected and analyzed for differential white blood cell count (lymphocyte) and haemoglobin (Hb). Data were analysed using descriptive statistics and analysis of variance. Values of AWG and DWT ranged from 0.1kg to 0.4kg and 1.1kg to 1.8 kg respectively, with 100% CSC and control having the least and the highest values among the treatments. FCR ranged from 1.6 to 4.9. Values of lymphocyte and Hb ranged from 35.2 to 54.0 % and 8.5 to 11.1g/dl respectively. Birds on 75% CSC based diets had blood profile more comparable with the control than those of other diets. CSC can replace up to 75% SBC without adverse effects on performance, haematological values and carcass quality of the birds. This reveals CSC as a potent source of protein for meeting the CP requirements of chickens.

Key Words: Chicken, Cottonseed Cake, Performance

W176 Serum biochemistry profile of broilers fed an enzymatic complex from *Trichoderma harzianum*. S. M. F. Marques[1], C. S. Minafra[2,1], J. H. Stringhini*[1], P. M. Rezende[1], M. A. Andrade[1], M. B. Cafe[1], and C. J. Ulhoa[1], [1]*Universidade Federal de Goias*, *Goiania, Goias, Brazil*, [2]*Universidade Federal de Viçosa*, *Viçosa, MInas Gerais Brazil*.

This experiment were carried out to evaluate serum profile of broilers fed from 1 to 21 d diets with an enzymatic complex (EC) supplement produced by *Trichoderma harzianum*, composed by xylanase, amylase, cellulase and lipase. EC was produced in the Enzimology Laboratory of the Biological Sciences Institute of the Federal University of Goias (UFG). 480 day-old male chicks were allotted in heated batteries located in the Veterinary College (UFG). In the first experiment, EC supplementation was evaluated in pre-starter phase (1 to 7 days) and the second in starter phase (8 to 21 days) in a randomized block design with four treatments and five replicates of 12 chicks each. Treatments in Exp. 1 were: vegetable pre-starter diet non-supplemented (VPS), or supplemented (VPSE), animal by-products and vegetable diet non-supplemented (APS), or supplemented (APSE); in Exp. 2: vegetable starter diet non-supplemented (VS), or supplemented (VSE),

animal by-products and vegetable diet non-supplemented (AS), or supplemented (ASE). Feed and water were offered ad libitum. From one chick per treatment, blood was collected by heart puncture at 7 and 21 days of age for serum separation and analyzed for Ca, P, total protein, alkaline phosphatase, K, Cl. Data was analyzed using SAEG 9.1 and means compared as Tukey test (5%). Ay 7 days, higher concentrations for Ca; Cl and K IN APS, VPS and VPSE, respectively, and higher concentrations for P was observed for the two highest concentrations, APS and VPS. But, for PA, higher results were obtained for VPS, APSE and VPS. No significance occurred for TP concentrations at 7 d and Ca at 21 d of age. At 21 d, highest concentration for P, K and AP for AS. Rations VS, VSE and ASE showed reduced Pt, K and Cl, respectively. These parameters indicates serum profile of broilers but didn't characterize the effect of enzymes addition in rations.

Table 1. Serum profile of Ca, P, Cl, K, TP, AP in broilers fed an *Trichoderma harzianum* enzimatic complex

7 days	VPS	VPSE	APS	APSE
Ca(mg/dL)	7.7ab	6.9b	8.9a	6.9b
P(mmol/L)	6.5a	3.8b	6.9a	3.7b
Cl(mmol/L)	149a	113c	1129c	130b
K(mmol/L)	4.8b	6.26a	5.15b	3.87c
TP(g/dL)	2.7a	2.4a	2.8a	2.4a
AP(UI/L)	895a	906a	813b	899a
21 days	VS	VSE	AS	ASE
Ca(mg/dL)	5.9a	7.2a	6.4a	6.1a
P(mmol/L)	6.2ab	6.2ab	7.7a	6.1b
Cl(mmol/L)	163a	135ab	144ab	128b
K(mmol/L)	4.4b	3.4b	5.8a	6.6a
TP(g/dL)	2.6ab	3.0a	2.8ab	2.3b
AP(UI/L)	892ab	865b	909a	888ab

Different letters in the row differ by Tukey test (5%)

Key Words: Biotechnology, Enzymes, Serum Profile

W177 Feeding performance in laying hens fed diets containing DAS-59122-7 maize grain compared with diets containing non-transgenic maize grain. C. M. Jacobs*[1], P. L. Utterback[1], C. M. Parsons[1], B. Smith[2], M. Hinds[2], D. Rice[2], M. Liebergesell[2], and T. Sauber[2], [1]*University of Illinois*, *Urbana*, [2]*Pioneer Hi-Bred International, Inc.*, *Johnston, IA*.

An experiment using 216 Hy-line W-36 pullets was conducted to evaluate the transgenic maize grain produced from a nonsegregating DAS-59122-7 line that contains the *cry*34Ab1 and *cry*35Ab1 genes from a *Bacillus thuringiensis (Bt)* strain, and the phosphinothricin acetyltransferase *(pat)*gene from *Streptomyces viridochromogenes*. Expression of the *cry*34Ab1 and *cry*35Ab1 genes confers resistance to corn rootworms, and the *pat* gene confers tolerance to herbicides containing glufosinate-ammonium. Pullets (20 wk of age) were placed in cage lots (3 hens/cage, 2 cages/lot) and were randomly assigned to one of three corn-soybean meal dietary treatments (12 lots/treatment) formulated with the following maize grains: near-isoline control (Control), conventional maize (Pioneer hybrid 3394), and transgenic test corn DAS-59122-7 (59122). The experimental diets were fed in mash form from 24 to 36 weeks of age. Differences between 59122 and Control group means were evaluated with statistical significance at $P<0.05$. Body weight and gain, egg production, egg mass, and feed efficiency for hens fed 59122 corn were not significantly different from the respective values for hens fed diets formulated with near-isoline maize grain. Egg component weights, Haugh unit measures, and egg weight class distribution were similar regardless of corn source. This research indicates that performance of hens fed diets containing 59122 maize grain, as measured by egg production and egg quality, was similar to that of hens fed diets formulated with the Control maize grain.

Key Words: *Cry*34Ab1, *Cry*35Ab1, Corn Rootworm

W178 Effects of supplemental humic substances on egg production and quality in laying hens. Q. Wang*, H. J. Kim, J. H. Cho, Y. J. Chen, J. S. Yoo, and I. H. Kim, *Dankook University*, *Cheonan, Choognam, Korea*.

The effects dietary of humic substances (HS) on egg production and egg quality were studied using 252 (55-wk old) ISA brown laying hens. They were divided into 21 groups of 12 hens each and seven groups (experimental units) were assigned to 1) CON (basal diet), 2) HS5 (basal diet + 5% humic substances) or 3) HS10 (basal diet +10% humic substances) in a completely randomized block design. Hens had free access to diets and water for 6 wk and egg production and egg quality were monitored over the 6-wk period. Results showed that 10% dietary HS decreased egg production and yolk diameter ($P<0.05$) compared to CON. Egg weight and yolk color were improved ($P<0.05$) in HS10 compared with CON. Egg shell breaking strength was increased ($P<0.05$) for hens fed HS5 diet compared with the others. There were no effects of treatments on egg shell thickness, yolk index, albumen height and haugh unit. The results suggested that the dietary supplementation of HS at 5 or 10% decreased egg production, but, HS5 could increase egg shell breaking strength. HS10 could increase egg weight and yolk color and decrease yolk diameter.

Key Words: Humic Substances, Egg Production, Egg Characteristics

W179 Enzyme complex containing NSP-enzymes and phytase improves the performance of broilers fed corn or wheat-based diets. A. V. Mori[1], M. Francesch[2], J. McNab[3], A. Knox[3], and P. A. Geraert*[1], [1]*Adisseo France SAS*, *Commentry, France*, [2]*Institut de Recerca i Tecnologia Agroalimentaries*, *Reus, Spain*, [3]*Nutrition Ltd.*, *Roslin, United Kingdom*.

Two experiments were conducted to investigate the benefits of a multi-enzyme complex containing carbohydrolase and phytase activities on the performance of Ross broiler chickens receiving corn or wheat-based diets. In Exp. 1, birds from 1 to 42 days were fed corn-based diets formulated to be phosphorus-restricted (reduction of 0.1% available phosphorus, [AP]) or phosphorus and energy-restricted (reduction of 0.1% AP and 60 kcal ME/kg), or phosphorus, energy and protein-restricted (reduction of 0.1% AP, 60 kcal ME/kg and 0.4% crude protein [CP]) in comparison to a positive control diet, meeting requirements for AP, ME and CP. In Exp. 2, birds from 1 to 40 days were fed wheat-based diets formulated to be phosphorus-restricted (reduction of 0.1% AP), or phosphorus and energy-restricted (reduction of 0.1% AP and 85 kcal ME/kg), or phosphorus, energy and protein-restricted

(reduction of 0.1% AP, 85 kcal ME/kg and 0.3% CP) in comparison to a positive control diet. In both experiments, the three reformulated diets were supplemented or not with RovabioTM Max at 100 g/t. This multi-enzyme complex provided 1,100 visco units of endo-β-1, 4-xylanase, 100 AGL units of endo-1,3(4)-β-glucanase, and 350 RPU of 3-phytase per kg of diet. Supplementation of the reformulated diets with the multi-enzyme complex improved ($P < 0.05$) weight gain of birds (4.0% and 4.6% in Exp.1 and 2, respectively), and weight gain values were comparable to those observed in the positive control groups. Additionally, in both studies, feed conversion of birds fed enzyme-supplemented diets did not differ ($P > 0.10$) from those of birds fed the positive-control diets. These results support that the dietary supplementation of multi-enzyme complex containing NSP-enzymes and phytase is efficient in reducing the phosphorus, energy and protein specifications of either corn or wheat-based diets without performance losses.

Key Words: Phytase, NSP-Enzymes, Broilers

W180 Effects of fermented wild-ginseng culture by-products on egg productivity, egg quality, blood characteristics and ginsenoside concentration of yolk in laying hens. H. D. Jang*, J. H. Cho, Y. J. Chen, J. S. Yoo, and I. H. Kim, *Dankook University*, *Cheonan, Choognam, Korea*.

The present study was to investigate the effect of fermented wild-ginseng culture by-product on egg production, egg quality and blood characteristics in laying hens. The animal used in the experiment were a total of 216 ISA brown laying hens(55 wk old). The experimental diets were basis diet (CON), 2.5% fermented wild-ginseng culture by-product replaced lupin in basis diet (WG1) and 5.0% fermented wild-ginseng culture by-product replaced lupin in basis diet (WG2). The laying hens were allotted into three treatments with six replicate pens per treatment by completely randomized design. Through the whole period of experiment, egg production was significantly increased in WG1 and WG2 treatments compared to CON treatment ($P<0.05$). Egg weight was significantly higher in WG2 treatment compared to CON treatment ($P<0.05$). Yolk color unit was greater in WG1 and CON treatments compared to WG2 treatment ($P<0.05$). Albumin height and haugh unit were significantly improved in WG1 treatment compared to WG2 treatment ($P<0.05$). Red blood cell was significantly lower in WG2 treatment than CON treatment ($P<0.05$). LDL cholesterol was significantly decreased in CON treatment compared to WG2 treatment ($P<0.05$). In conclusion, fermented wild-ginseng culture by-product could improve egg production and egg weight in laying hens.

Key Words: Fermented Wild-Ginseng Culture By-product, Egg, Layer

W181 Effects of enzyme addition to corn-soybean-meal-based diets on performance and processing yields of guinea fowl (*Numida meleagris*) broilers. H. L. Santiago*, J. A. Orama, and A. A. Rodríguez, *University of Puerto Rico*, *Mayagüez, Puerto Rico*.

Recent studies have demonstrated the benefits of supplementation with enzymes such as amylases and proteases to broiler diets based on corn and soybean meal. However, these benefits cannot be extrapolated to the commercial production of other species of domestic animals. The objective of this study was to determine the effects of diet fortification with Avizyme (AV) on guinea broiler growth performance and processing yields. A total of 600 guinea keets were randomly assigned to four dietary treatments with 10 replications of 15 birds per pen and reared until market age (84 d) in a conventional poultry house. Treatments consisted in diets containing 0 (control), 0.025, 0.050, and 0.075% of AV. Birds and feed were weighed weekly until 84 d of age to determine body weight (BW), feed intake (FI) and feed conversion ratio (FCR). At 84 d, 50 birds per treatment were processed to evaluate carcass composition. The weights of new york dressed (NYD), hot ready to cook (HRTC), cold ready to cook (CRTC), and fat pad (FP) were obtained and yields calculated as a percentage from live BW. No differences among treatments were observed for BW, FI, and FCR during the first 28 d of growth. However, from 28 to 84 d of age diet fortification with AV significantly improved FCR and reduced FI when compared to the control diet. At 84 d of age, birds fed diets containing 0.025 AV had significantly lower FI than controls; while birds fed diets with 0.050 and 0.075 % AV had FI similar to the rest of the dietary treatments. Birds fed diets containing 0.025 and 0.075 % AV obtained lower FC than that of controls. Diets containing 0.050% AV had FC similar to the other AV inclusion levels or the control. No significant differences in mortality and processing yields (NYD, HRTC, CRTC, and FP) were observed among treatments. The data obtained suggests that supplementation of corn and soybean meal diets with at least 0.025% improve FCR of guinea broilers without affecting BW at market age and processing yields.

Key Words: Guinea Fowl, Avizyme, Performance

W182 Dietary flaxseed supplementation affects broiler live performance. V. L. Carney*[1], M. J. Zuidhof[1], M. Betti[2], B. L. Schneider[1], R. A. Renema[2], F. E. Robinson[2], and D. R. Korver[2], [1]*Alberta Agriculture and Food*, *Edmonton, Alberta, Canada*, [2]*University of Alberta*, *Edmonton, Alberta, Canada*.

This experiment was conducted as a 2 X 8 factorial, with two dietary levels of ground flaxseed (10 and 17%) and eight durations of inclusion in the diet prior to processing (0 [Contro], 4, 8, 12, 16, 20, 24 and 35 d). Six hundred fifty-six Ross x Ross 308 mixed–sex broilers were evaluated in this study. Birds were weighed as a group each time feed was changed with each new duration. With more than 20 d of feeding duration, the diet containing 17% flaxseed significantly decreased BW and gain and increased feed conversion compared to the diet containing 10% ground flaxseed ($p<0.0001$). Feed intake was not significantly affected. A cost analysis showed that feeding flaxseed is costly due to production losses and increased feed costs. Feeding 10% flaxseed for 4 days increased cost per kg by $0.073/kg. Cost of production was more than $0.97/kg greater for the 17% flaxseed treatment fed for 35 days as compared to no dietary flaxseed. In conclusion, different levels and durations of flaxseed feeding significantly depressed broiler performance and increased associated costs of production.

Key Words: Flaxseed, Polyunsaturated Fatty Acids, Alpha-Linolenic Acid

W183 Effect of alternate lutein and flaxseed enriched diet combinations on production parameters in laying hens. D. Franco-Jimenez*[1,3], R. Renema[1], M. Zuidhof[2], and F. Robinson[1], [1]*University of Alberta*, *Edmonton, Alberta, Canada*, [2]*Alberta Agriculture, Food and Rural Development*, *Edmonton, Alberta, Canada*, [3]*California State Polytechnic University*, *Pomona*.

A total of (144) 56 wk old Lohman White layers were randomly selected and assigned to individual cages (24/diet) with 14L:8D. The hens were fed during 60 days with a regular wheat soybean control (C) diet or enriched diets: 500ppm Lutein diet (L), 10% Flaxseed diet (F) as a source of omega fatty acids, Lutein and flaxseed diet (LF), Alternate one diet (LF1) (Alternating L and F diets every other day), and Alternate two diet (LF2) (Alternating L and F diets every second day). Egg production (EP), feed intake (FI), egg weight (EW) and body weight (BW) data were collected over time and analyzed using repeated measures and proc Mixed of SAS in a completely randomized design. Bone strength, ovary morphology, fleshing (breast weight) and fatness (fat pad) and other carcass characteristics were assessed at 65 wk of age on all birds using proc mixed of SAS. The results showed not treatment effect on EP, poor shell eggs, settable eggs, Haught unit, bone strength, shank with, shank length, and ovary and oviduct weight. Yolk color (Roche® fan) was higher when lutein is added to any of the diets ($p<0.05$). Shell quality (specific gravity, shell weight and shell thickness) was significant reduced ($p<0.05$) on the LF1 and LF2 diets. Breast weight, liver weight and BW was significant reduced on diets containing flaxseed, while fat pad was lower on LF, LF1 and LF2 diets compared to control. Egg weight was lower for LF and LF2 diets and yolk weight was lower for all diets compared to C. Feed intake showed diet by time interaction with not specific pattern for diet over time; however, FI on LF1 and LF2 diets was higher during lutein feed days. These results indicate that using LF1 and LF2 diets do not affect EP, or reduce other production parameters dramatically, maintaining reproduction status and representing a good alternative for enrichment of the egg yolk with a possible reduction of the antagonistic effect observed for flaxseed over lutein incorporation.

Key Words: Laying Hens, Lutein, Omega Fatty Acids

W184 Impact of different sources of dietary unsaturated fatty acids on productive performance and immunological status of broiler chickens subjected to heat stress. M. N. Makled*, A. A. El-Sebaie, O. S. Afifi, and A. A. Nafady, *Assiut University*, *Assiut, Egypt*.

One hundred and eight unsexed one-day old Ross broiler chicks were equally allotted to three groups. Group1 (control) was fed a basal diet containing 4% palm oil which is poor in polyunsaturated fatty acids (PUFA); group2 was fed the basal diet after replacing palm oil with 4% linseed oil which is rich in linolenic acid (ω3); and group3 was fed the basal diet after replacing palm oil with 4% sunflower oil which is rich in linoleic acid (ω6). The experiment lasted for 7 weeks, and the birds were subjected to heat stress (HS) started from the age of 28 days at 35°C for eight hours daily. At 4 weeks of age, all birds were injected intravenously in the wing vein with 0.5 ml of 15% sheep red blood cells (SRBCs) suspension in saline solution of packed SRBCs. Thereafter, different criteria were estimated weekly: body weight, feed efficiency, mortality, blood picture, serum T3 and T4 concentration, and antibody titer response to SRBCs. Also, histopathological changes in bursa and thymus glands were examined at 7 weeks old. The obtained results indicated that different dietary sources of PUFA had no significant effect on the performance of broilers subjected to heat stress from 4 to 7 weeks of age. Meanwhile, their effects on immunological properties were variable. Sunflower oil caused significant increase of antibodies formation, RBCs count, and haematocrit at the first week of subjection to HS. After three weeks of HS, total leukocyte count in palm oil group was significantly lower than in linseed oil group or sunflower oil group. Lymphocytes % increased significantly in linseed oil group and sunflower oil group even before starting heat stress as compared with palm oil group, however, heterophils increased significantly in palm oil group as compared with the other groups. Hence, H/L ratio was significantly lower in linseed oil and sunflower oil groups. Histopathological examination indicated obvious increase in lymphocytes and thymocytes proliferation in bursa and thymus glands, respectively, in linseed oil and sunflower oil groups which may affect the immune potentiality of broilers.

Key Words: PUFA, Heat Stress, Immunity

W185 Dietary supplementation with *atractylodes macrocephala koidz* polysaccharides enhances growth performance and development of immune organs in ducks. L. L. Li*[1], Y. L. Yin[1], B. Zhang[2], G. H. Wen[1,2], A. K. Li[3], Z. P. Hou[1], P. Zhang[1], and G. Y. Wu[1,4], [1]*The Chinese Academy of Sciences*, *Changsha, Hunan, China*, [2]*Hunan Agricultural University*, *Changsha, Hunan, China*, [3]*Academy of State Grain Administration of China*, *Beijing, China*, [4]*Texas A&M University*, *College Station*.

This study was conducted to determine the effects of dietary supplementation with *atractylodes macrocephala koidz* polysaccharides (AP) on growth performance and immune function in ducks. A total of 480 one-day-old Cherry Volley ducks were assigned randomly to one of 7 treatment groups, representing dietary supplementation with 0% (control), 0.2, 0.4, 0.6 or 0.8 AP or 0.02% terramycin (an antibiotic) to a corn- and soybean meal-based diet. There were 4 replicates for each treatment group, with 20 and 18 ducks per replicate in Phase I (d 1-14) and Phase II (d 15-28), respectively. All animals had free access to their respective diets and drinking water. In Phase I, dietary supplementation with 0.8% AP increased ADG by 10%, improved feed efficiency by 11%, and altered the ratios of the thymus and Bursa of Fabricius weights to BW ($P< 0.05$). No effect of AP supplementation was observed on the ratio of spleen to BW or serum concentrations of IGF-I and IGF-II ($P>0.05$). In Phase II, dietary supplementation with AP had no effect on ADG or the ratios of the spleen, thymus, and Bursa of Fabricius weights to BW ($P>0.05$), increased feed efficiency and serum concentrations of IGF-I ($P<0.05$), and reduced serum concentrations of IL-6. In both phases, dietary supplementation with other doses of AP had no effect on ADG ($P>0.05$), whereas the antibiotic treatment improved feed efficiency ($P<0.05$) without altering the measured parameters of the immune function. These results indicate that dietary supplementation with 0.8% AP resulted in a beneficial effect on growth performance and development of immune organs in ducks.

Key Words: Polysaccharides, Herbs, Ducks

W186 Production of low cholesterol eggs by dietary supplementation of probiotics and essential trace minerals in laying hen. S. J. You*, C. W. Kang, and B. Y. An, *KonKuk University*, *Seoul, Korea*.

For health-conscious consumers low cholesterol eggs may be an attractive and there were many efforts to reduce content of egg cholesterol using drugs, natural ingredients, mineral, etc. This experiment was conducted to develop dietary regimes for production of low cholesterol eggs by supplementing natural ingredients and trace minerals to laying hen feeds. Two hundred ten Hy-Line Brown layers, 53 weeks of age, used to investigate the effects of feeding diets containing various levels of probiotics and minerals such as copper and selenium on the content of egg yolk cholesterol. The layers were divided into seven groups and fed a commercial diet(control) or one of six experimental diets containing mixtures of various levels of probiotics(0.3, 0.5 and 0.7%), copper(100, 200 and 250 ppm) and selenium(0.3, 1.0 and 1.5 ppm) for 6 weeks. There were no significant differences in egg and eggshell qualities among the groups. The contents of egg yolk cholesterol of the birds fed the mixtures of various levels of probiotics, copper and selenium were significantly reduced by 13.9~25.6% as compared to those of the control($P<0.05$). The expression of 3-hydroxy-3-methylglutaryl coenzyme A reductase mRNA was decreased by the dietary treatments($P<0.05$). In conclusion, dietary mixtures of probiotics, copper and selenium were found to lower cholesterol contents of egg without any adverse effect on laying performance and egg qualities.

Key Words: Egg Cholesterol, Probiotics, Selenium

W187 A dose response comparison of MINTREX® Zn versus Zn-methionine in the presence of a Cu-Zn antagonism in 19 day-old broiler chickens. R. B. Shirley*, C. W. Wuelling, T. R. Hampton, J. J. Dibner, and C. D. Knight, *Novus International, Inc.*, *Saint Charles, MO*.

The following study evaluated the bioavailability of two zinc (Zn) sources, MINTREX® Zn (Mtx-Zn) and Zn-methionine (Zn-Met). The semi-purified basal diet contained 8.5 mg/kg (ppm) Zn and 10 ppm copper (Cu), to which Mtx-Zn or Zn-Met supplied up to 0, 15, 30, or 45 ppm total dietary Zn on an iso-nitrogenous, caloric and methionine-basis (seven treatments). Two additional treatments were added to the experiment by supplementing 250 ppm Cu from $CuSO_4 \bullet 5H_2O$ in diets that contained a dietary Zn level of 30 ppm from either Mtx-Zn or Zn-Met. Broilers were fed the Zn-deficient basal diet for 7 d, and then fed the respective dietary treatments until 19 d. Performance, foot pad development, as well as tibia and hepatic mineral status were measured; tibia histology and foot pad scores were also evaluated. Data were analyzed by ANOVA; and pair-wise comparisons were made to determine if there was a difference in Zn sources at each level of supplementation. Broilers fed the Zn-deficient basal diet consistently had the poorest body weight gain, feed intake, feed conversion, percent tibia ash and tibia ash Zn, and foot pad score ($p < 0.0001$). The addition of Mtx-Zn or Zn-Met resulted in a dose-dependent improvement in each of the latter parameters ($p \leq 0.0001$). There was no difference in the efficacy of Zn sources when compared across the three levels of supplementation. Adding Cu at 250 ppm in the presence of 30 ppm Zn, however, reduced body weight gain ($p = 0.0200$), tibia Cu ($p = 0.0026$) and hepatic Cu ($p = 0.0004$) in birds that consumed Zn-Met when compared to birds consuming Mtx-Zn. These data indicate no difference in the bioavailability of the two Zn sources under standard laboratory battery cage conditions. However, data indicate greater bioavailability of Mtx-Zn in the presence of excess dietary Cu, the conditions under which one would expect improved bioavailability of a chelated trace mineral.

MINTREX® Zn is a trademark of Novus International, Inc. and is registered in the United States and other countries.

Key Words: MINTREX® Zn, Zinc methionine, Mineral antagonism

W188 Use of enriched Selenium yeasts in laying hens diet: effects on production, metabolism, egg Se content and organ Se content. G. Invernizzi*, M. Ferroni, A. Agazzi, R. Rebucci, G. Savoini, A. Baldi, and V. Dell'Orto, *University of Milan*, *Milan, Italy*.

Sixty-four laying hens were assigned to four experimental treatments of 16 animals each allotted in cages per pair: C, control, SS, sodium selenite, Y1, treatment one, Y2, treatment two. All hens were fed the same basal diet (CP 18.30%, EE 6.03%, NDF 10.60%, Ca 3.34% on as-fed basis) without organic Se either than in the feedstuffs (C), plus 0.4ppm sodium selenite (SS), plus 0.4ppm of selenium and *S. cerevisiae* strain 1 (Y1), plus 0.4ppm of selenium and *S. cerevisiae* strain 2 (Y2) for eight weeks from starting laying. Productive performances were evaluate weekly, while egg samples for selenium content were collected on day 0, 18, 36 and 56 of laying period. Blood serum samples for metabolic profile (ALT, AST, ALP, NEFA, total protein, total bilirubin, albumin, cholesterol, glucose, urea content) and Se status were collected at slaughtering. Se organs content (liver, muscle, and skin) was determined on samples collected at slaughtering. No differences were detected on laying rate ($P>0.05$). Serum metabolites did not shown any statistical differences except for lower AST levels in Y1 (167UI/l) and in Y2 (170UI/l) than SS (249UI/l; $P<0.05$). Se egg content was significantly increased in Y1 and Y2 than C and SS (respectively: 1.6ppm, 1.4ppm, 0.5ppm and 0.9ppm on DM basis; $P<0.001$). Serum Se content was higher in Y1 and Y2 than other groups (Y1=0.33ppm, Y2=0.31ppm, C=0.15ppm, SS=0.21ppm on DM basis; $P<0.05$). In the same way liver Se content (Y1=1.92ppm, Y2=2.56ppm, C=1.36ppm, SS=1.65ppm; $P<0.01$), skin Se content (Y1=0.40ppm, Y2=0.43ppm, C=0.22ppm, SS=0.31ppm on DM basis; $P<0.05$), and muscle Se content (Y1=1.22ppm, Y2=0.94ppm, C=0.42ppm, SS=0.39ppm on DM basis; $P<0.05$) were higher in enriched Se yeast groups. The administration of Se enriched live yeasts in laying hens significantly increased the serum and organs Se content with no detrimental effect on productive performance.

Key Words: Selenium Yeast, Laying Hen, Sodium Selenite

W189 Performance of alternative meat chickens for organic markets: Impact of genotype, methionine level, and methionine source. A. C. Fanatico*, T. O'Connor-Dennie, C. M. Owens, and J. L. Emmert, *University of Arkansas*, *Fayetteville*.

Synthetic forms of the amino acid methionine (MET) will be banned from organic poultry diets in the future under the USDA National Organic Program. For organic producers possible alternatives include the use of slow-growing genotypes, which may have lower MET

requirements, and feed formulations utilizing only intact protein sources of MET (no synthetic MET). Three genotypes with different growth rates (Slow, Medium, and Fast) were given a low-MET basal diet or diets containing intermediate or high MET levels that were formulated with or without synthetic DL-MET; thus 5 experimental diets were fed to each genotype. Digestible MET levels (for the low, intermediate, and high MET diets) were 0.30%, 0.36%, and 0.42% in the starter phase, 0.26%, 0.30%, and 0.34% in the grower phase, and 0.22%, 0.26%, and 0.30% in the finisher phase. Twenty male birds were randomly assigned to pens with 5 replicate pens per treatment. Slow, Medium, and Fast birds were raised to 77, 63, and 49 d of age, respectively, and placement of the different genotypes was staggered in order to process all birds on the same day. Carcass and parts yield were calculated from 5 birds from each replicate. Genotype had a significant impact on weight gain, feed intake, feed efficiency, and yield ($P < 0.05$). The Fast birds had higher weight gain, feed efficiency, carcass and parts yield than slower-growing birds. Level of MET had a numerical but not significant impact on weight gain and feed efficiency. However, breast yield of all genotypes was affected by MET level, with higher breast yields from treatments with higher levels of MET ($P < 0.05$). The Slow genotype had lower breast yield than Fast but higher wing and leg yield ($P < 0.05$). Diet formulation without DL-MET (using intact-protein diets with higher crude protein levels) did not compromise growth or yield. These data exhibit the impact of genotype and MET level on performance of birds for organic markets, and demonstrate the use of intact-protein sources as an alternative to synthetic DL-MET.

Key Words: Organic, Methionine, Slow-Growing Poultry

W190 Fractional protein synthesis rate in breast muscle and liver tissues of broiler breeder hens before and after sexual maturity based on using ^{15}N-Phe, and LC-MS and GC-C-IRMS. M. K. Manangi* and C. N. Coon, *University of Arkansas*, *Fayetteville*.

Protein turnover is a continuous process of protein synthesis and degradation in the living system. The literature indicates that though whole body protein synthesis increases, the proportion of these proteins synthesized [i.e. the fractional synthesis rate (FSR), k_s] each day declines. The main objective of this study was to measure k_s for breast muscle and liver tissues in broiler breeder hens at 22 wk (before laying) and 26 wk (after first egg) of age. One hundred, 20 wk old, broiler breeder hens (Cobb500) of uniform body weight were placed in individual breeder cages and fed following breeders' recommendation. Seven birds of uniform body weight were selected each sampling time. Birds were injected with a flooding dose of L-Phe solution (150mM, 38 atom percent excess [^{15}N]Phe prepared from L-Phe (^{15}N, 98%+)) via wing vein at a rate of 10 mL/kg body weight. Plasma, muscle, and liver samples were collected after a 10 min isotopic incorporation period. Acid-soluble fraction, extracted in 2% (w/v) perchloric acid, containing free amino acids was separated from the protein precipitate, and the free and protein-bound Phe enrichment ratios (^{15}N:^{14}N) were measured using LC-MS (High Performance Liquid Chromatography Mass Spectrometry) and GC-C-IRMS (Gas chromatography-Combustion-Isotope Ratio Mass Spectrometry), respectively. The results indicate a decline ($P=0.1856$) in k_s from 38.96%/d at 22 wk to 32.84%/d at 26 wk for muscle and a significant ($P<0.05$) increase in k_s from 79.65%/d at 22 wk to 106.36%/d at 26 wk for liver. In conclusion, the decline in k_s for muscle and increase in k_s for liver at sexual maturity shows that breeders are changing tissue protein synthesis rate in conjunction with egg formation. A better understanding of breeder changes in breast muscle and liver FSR, protein degradation rates, and protein accretion may provide an opportunity to optimize the pullet rearing program, body composition, and breeder intake of nutrients for the purpose of increasing hatching egg production.

Key Words: FSR, Broiler Breeder Protein Degradation

W191 Effects of methionine versus cystine supplementation on egg production parameters and feather quality in Bovan strain laying hens from 20 to 70 weeks of age. S. E. Scheideler*, P. Weber, and S. Shields, *University of Nebraska*, *Lincoln*.

A study was conducted to test the effects of sulfur amino acid supplementation from either methionine (M)(DL-methionine) or cystine (C) (from feather meal) on feather quality and egg production parameters in laying hens from 20 to 70 wks of age. Hens were fed 7 dietary treatments in three phases. Phase I was an 18% protein (P) basal diet with .33% M and .37% C. Diets 2-4 had added M to .38, .40 and .42 % M and diets 5-7 had .41, .44 and .45% C added to the basal C levels. Phase II was a 16 % P basal diet with .28% M and .32% C. Diets 2-4, had added M to .32, .33 and .34% M and diets 5-7 had .32, .36 and .42% added C. Phase III was a 15% P basal diet with .28% M and .35% C. Diets 2-4, had added M to.32, .34 or .37% M and diets 5-7 had .38, .40 or .43% C. Diets were isocaloric and formulated to meet Bovan strain nutrient intake recommendations. Diet significantly affected egg production (EP) during all 3 phases of the trial. During P I, hens fed the highest levels of M (.42%) or C (.45%) had greater EP compared to the other levels of M and C supplementation. This trend was continued through P II and III. However, the lower levels of M and C supplementation did not benefit EP above the basal diet levels of M and C. Egg weights (EW) were only significantly affected during P II, during which time hens fed the highest level of M (.34%) had the greatest EW, followed by hens fed .32% C. C and M supplementation during P III inconsistently improved EW. Feather scores (FS) were conducted every 2 wks during the trial using 2 different scoring systems; a method developed by Tauson and the scales used by Webster and Hurnik. Results indicate no sig effects of diet M or C on feather scores, but sig effects of age (Phase) on FS, with rapid deterioration of FS during P II and III of the study. In summary, FS is more controlled by age than diet M or C during the first cycle of EP from 20-70 wks of age.

Key Words: Feather Score, Methionine, Cystine

W192 Comparison of various methods for endogenous ileal amino acid flow determination in broiler chickens. A. Golian*[1], W. Guenter[1], D. Hoehler[2], and C. M. Nyachoti[1], [1]*University of Manitoba*, *Winnipeg, MB, Canada*, [2]*Degussa Corporation*, *Kennesaw, GA*.

The purpose of this study was to compare estimates of ileal endogenous amino acid flow (IEAA) determined in broiler chicks with a nitrogen-free diet (NfD), diets containing intact casein or enzymatically hydrolyzed casein (EHC) and the regression method (RM). Male Ross broiler chicks were fed a commercial starter diet from d 1 to 15 of age and the following test diets from d 15 to 21: a NfD and diets containing 5, 10 or 15% casein or EHC as the sole protein source. All

diets contained chromic oxide as a digestibility marker. Each diet was assigned to six replicate cages, each with 10 birds. On d 21, birds were killed to sample ileal digesta. Compared with the NfD, the average IEAA values for the casein or EHC diets were higher (P<0.05) for all AA except for Arg, Phe and Pro whose values for casein and NfD diets were similar. The ileal flow of Met, Cys, Lys, Val and Ser in birds fed the casein or EHC diets were similar (P>0.10) but the flow of all other AA was higher (P<0.05) in EHC-fed birds than in those fed the casein diet. Feeding increasing levels of casein or EHC linearly (P<0.01) increased ileal AA flow. Estimates of IEAA obtained with the RM were similar (P>0.10) for all AA except for His (103 vs. 64 mg/kg DM) and Ser (418 vs. 577 mg/kg DM) whose values were higher and lower, respectively, for casein than for EHC (P<0.05). Compared with the NfD method, IEAA values obtained with the RM were similar for all AA except Met (69 vs. 77 mg/kg DM) with casein and Ile (209 vs. 321 mg/kg DM), Val (281 vs. 341 mg/kg DM) and Ser (357 vs. 577 mg/kg DM) with EHC that were higher (P<0.05). The present results show that IEAA values determined with NfD, EHC and casein diets are different for some AA and that, for most AA, values obtained with the NfD and the RM involving feeding graded levels of casein or EHC are comparable. Thus, using IEAA values obtained with either the NfD method or the RM to calculate standardized ileal AA digestibilities will give similar values.

Key Words: Ileal Endogenous Amino Acid Flow, Broilers

W193 Ideal ratio of Arg, Ile, Met, Met + Cys, Thr, Trp, and Val relative to Lys for 28 to 34-week-old laying hens. S. Roberts*[1], B. Kerr[2], D. Hoehler[3], and K. Bregendahl[1], [1]*Iowa State University*, *Ames*, [2]*NSRIC, USDA/ARS*, *Ames, IA*, [3]*Degussa Corporation*, *Kennesaw, GA*.

Seven separate experiments were conducted with Hy-Line W-36 hens to determine the ideal ratio of Arg, Ile, Met, Met + Cys, Thr, Trp, and Val relative to Lys for maximal egg mass (EM). The experiments were conducted simultaneously and were each designed as a randomized complete block design with 60 experimental units (each consisting of 1 cage with 2 hens) and 5 dietary treatments. The 35 treatment diets were made from a common basal diet (2,987 kcal/kg ME; 12.3% CP), formulated using corn, soybean meal, and meat and bone meal. The true digestible (TD) amino acid contents in the basal diet were determined using the total fecal collection precision-fed assay with adult cecectomized roosters. Crystalline L-Arg, L-Ile, L-Lys, DL-Met, L-Thr, L-Trp, and L-Val (all considered 100% TD) were added to the test diets at the expense of cornstarch to make the respective test amino acid first limiting and to yield 5 graded inclusions of the test amino acid. Hens were fed the treatment diets from 26 to 34 wk of age, with the first 2 wk considered a depletion period. Egg production was recorded daily and egg weight was determined weekly on 48-h eggs; EM was calculated as egg production × egg weight. The requirement for each amino acid was determined using the broken-line regression method and the ideal amino acid ratio was subsequently calculated. Consumption of Arg did not affect EM, thus an optimum ratio could not be derived. The daily TD amino acid requirements used to calculate the ideal amino acid ratio for maximum EM were 426 mg Ile, 538 mg Lys, 253 mg Met, 506 mg Met + Cys, 414 mg Thr, 120 mg Trp, and 501 mg Val. The ideal amino acid ratio for maximum EM was Ile 79%, Met 47%, Met + Cys 94%, Thr 77%, Trp 22%, and Val 93% on a TD basis relative to Lys.

Key Words: Ideal Amino Acid Ratio, Laying Hen, Egg Mass

W194 Carcass yield of modern vs 1970's heritage broilers fed drug free recommended and low protein diets. A. Golian*[2], T. A. Woyengo[1], C. Bennett[3], W. Guenter[1], and H. Muc[1], [1]*University of Manitoba*, *Winnipeg, Manitoba, Canada*, [2]*University of Ferdowsi*, *Mashhad, Iran*, [3]*Manitoba Agriculture, Food and Rural Initiatives*, *Winnipeg, Manitoba, Canada*.

Six hundred mixed sex day-old chicks from each of a modern (Ross, RS) and two 1970's heritage breeds (HB1 and HB2) broilers were randomly placed in 10 floor pens and fed two diets containing 3050 kcal ME/kg and either 22 or 19% crude protein (5 pens/diet/breed) from 1 to 30 d of age. All the birds were fed the diet containing 19% crude protein from 31 to 63 d of age. Comparisons of carcass yield cuts were carried out at 49 and 63 d of age. On the day of slaughter 10 birds from each pen were wing banded and deprived of feed at 4:00 AM, weighed at 8:00 AM, shipped and processed 9-10 h after feed removal. Carcasses were chilled on ice overnight, weighed and cut into parts. The level of dietary protein influenced (P<0.01) carcass yield and skinless breast fillet but not any other cuts at 49 d of age. Carcass yield of modern RS birds was greater (P<0.01) than for the HB1 and HB2 breeds (69.2, 65.8 and 65.6%, respectively). Skinless breast fillet as percent of carcass was 24.1, 18 and 17.5% for the RS, HB1 and HB2 breeds, respectively. Boneless skinless thighs were heavier (P<0.05) in RS vs. heritage breeds whereas thigh skin, thigh fat, drumsticks, wings and rack as a percent of carcass were smaller (P<0.01) for RS birds than the heritage breeds. A significant diet by breed interaction was only observed for carcass yield and breast fillet. At 63 d of age, diet had no effect (P>0.05) on carcass yield, however breast fillets were larger (P<0.01) for birds fed the 22% protein diet to 30 d of age. In general the breed response was the same as at 49 days. At 63 d of age carcass yield was significantly (P<0.01) greater for males than females whereas the opposite was true for breast fillet yield. Overall the modern day broiler is superior in carcass yield and breast fillet yield.

Key Words: Broiler, Breed, Carcass Yield

W195 Performance and carcass parameters of broiler chicken from 1 to 45 d fed with different levels and source of vitamin D. J. A. G. Brito[1], A. G. Bertechini*[1], J. C. C. Carvalho[1], R. L. Rios[1], J. O. B. Sorbara[2], and F. J. Piraces[2], [1]*Universidade Federal de Lavras, DZO*, *Lavras, MG, Brazil*, [2]*DSM Nutritional Products*, *Sao Paulo, SP, Brazil*.

Different levels and source of vitamin D were investigated in this study. 1500 male Cobb 700 were allocated in 100 wire cages with feed and water ad libitum. Ten programs of vitamin D supplementation according to the broiler chicken age were study (1-21 d; 22-38 d and 39-45 d) with four levels of vitamin D (20-16-10; 37,5-30-18,75; 87,5-70-43,75 and 137,5-110-68,75 mg/ton) another two treatments were add with both source of vitamin D\ (D3 and 25(OH)D3) and two treatments with both source of vitamin D (50 D3 + 37,5 25(OH)D3; 40 D3 + 30 25(OH)D3; 25 D3 + 18,75 25(OH)D3 and 50 D3 + 70 25(OH)D3; 40 D3 + 56 25(OH)D3; 25 D3 + 35 25(OH)D3 mg/ton). The experimental design was a complete randomized in a factorial arrangement (4 levels of vitamin D supplementation according to the bird age and 2 source of vitamin D) plus two treatments (with both source of vitamin D) with 10 replications. The feed were base in corn/soybean meal without growth promoter and with 500 FTU/ton feed of phytase. Performance parameters as body weight gain (BWG, g), feed intake (FI, g), and feed conversion were analyzed from 1 to

45 d. Carcass yield, breast yield and leg yield were evaluated at 45 d of age. Feed intake and body weight gain were statistical higher for the treatments with combined source of vitamin D. Carcass yield was proximally 1% higher when the 25(OH)D3 were used compared to vitamin D3. Feed conversion, breast yield, and leg yield were not affected by the level or source of vitamin D.

Table 1. Performance and carcass yield at 45d

Source	Program/age	FI	BWG	Carcass Yield
D3	20-16-10	5322	3051	75.0
D3	37.5-30-18.75	5275	3054	73.9
D3	87.5-70-43.75	5286	3057	74.5
D3	137.5-110-68.75	5312	3078	74.5
Mean D3		5299	3060	74.5b
25(OH)D3	20-16-10	5302	3053	75.1
25(OH)D3	37.5-30-18.75	5291	3068	75.9
25(OH)D3	87.5-70-43.75	5305	3064	75.0
25(OH)D3	137.5-110-68.75	5325	3081	75.8
Mean 25(OH)D3		5306	3067	75.5a
D3+25(OH)D3	50+37.5; 40+30; 25+18.75	5369	3104	75.7
D3+25(OH)D3	50+70; 40+56; 25+35	5385	3123	75.7
Mean D3+25(OH)D3		5377a	3114a	75.7
Mean Factorial		5302b	3063b	75.0

Key Words: Vitamin, Performance, Carcass

W196 Performance and bone characteristics of broiler chicken from 1 to 21 d fed with different levels and source of vitamin D. J. A. G. Brito[1], A. G. Bertechini*[1], J. C. C. Carvalho[1], E. J. Fassani[1], J. O. B. Sorbara[2], and F. J. Piraces[2], [1]*Universidade Federal de Lavras, DZO*, *Lavras, MG, Brazil*, [2]*DSM Nutritional Products*, *Sao Paulo, SP, Brazil*.

Different levels and source of vitamin D were investigated in this study. 1500 male Cobb 700 were allocated in wire cages with feed and water ad libitum. From 1 to 21 d four levels (800; 1500; 3500 and 5500 IU) of vitamin D were provided by two source of vitamin D (D3 or 25(OH)D3 known as HyD) another two treatments were add with both source of vitamin D 2000 IU by D3 + 1500 IU by Hy-D; and 2000 IU by D3 + 2800 IU by Hy-D.The experimental design was a complete randomized in a factorial arrangement (4 levels of vitamin D supplementation and 2 source of vitamin D) plus two treatments (with both source of vitamin D) with 10 replications. The feed were base in corn/soybean meal without growth promoter. Performance parameters as body weight gain (BWG, g), feed intake (FI, g), and feed conversion (FC, g/g) were analyzed from 1 to 21 d. Bone ash (%), calcium (%), phosphorus (%) and tibial dyschondroplasia (TD, %) were evaluated at 21 d of age. At 21 d-age the feed intake was affected just when the level of vitamin D was marginal with statistical higher feed intake with D3. The BW gain at 21 d were higher (P<0.05) when the two source of vitamin D were combined. The feed conversion at 21 d was statistical better when the highest levels of vitamin D were combined. The percentage of Ca on bone were statistical higher for 25(OH)D3 source just when the level of supplementation were between 25 and 37,5 mg of D3/ton feed. TD were lower (P<0.05) in the birds that received just Hy-D or when combined with D3.

Table 1. Performance from 1 to 21 d-age and bone ash, calcium, and TD at 21d.

Source	Level	FI	BWG	FC	Ash	Ca	TD
D3	20	1124a	804	1.40	52.1	19.3b	75
D3	37.5	1111	805	1.38	54.1	19.4B	75
D3	87.5	1112	813	1.37	54.3	20.2	58
D3	137.5	1123	821	1.37	54.4	19.8	50
Mean D3		1117	811b	1.38	53.8b	19.7	65b
HyD	20	1104b	806	1.37	53.4	20.1a	58
HyD	37.5	1115	810	1.38	54	20.2A	50
HyD	87.5	1113	811	1.37	54.1	20	42
HyD	137.5	1117	821	1.36	54.4	20.1	33
Mean HyD		1112	812b	1.37	54b	20.1	46a
D3+HyD	50+37.5	1146	823	1.39a	54.5	20.1	42
D3+HyD	50+70	1140	835	1.37b	54.1	20.2	50
Mean D3+HyD		1143	829a	1.38	54.3a	20.1	46

a, b; A, B (P<.05)

Key Words: Vitamin, Bone, Performance

W197 Performance and carcass yield of four quail genetic groups selected for meat production. C. Móri, E. A. Garcia, A. C. Pavan, A. Piccinin, C. C. Pizzolante, R. M. S. Emediato*, A. B. G. Faitarone, M. R. Scherer, D. A. Berto, and S. A. Maestá, *São Paulo State University*, *Botucatu, São Paulo, Brazil*.

The study aimed to evaluate the performance and carcass yield of four meat quail genetic groups. It was used one thousand and two hundred quail of 1 day of age until it have complete 42 days of age. The birds were allocated in a completely randomized design with four treatments (A, B, C and D) and five replicates of 60 birds each. The quails were weighted once a week in order to evaluate weight gain and feed consumption. Mortality rate was recorded daily. When the birds have completed 42 days of age, ten quails from each replication were identified and slaughtered in order to evaluate carcass and cuts yield. During the experimental period, the genetic group C has shown higher values for final weight and daily weight gain. No differences were observed among groups for feed consumption, feed efficiency, mortality, carcass weight, carcass yield and breast percentage. Genetic group D has shown higher values for wings, legs and breast meat percentage. In conclusion, there are differences of performance and carcass and cuts yield among quail genetic groups selected for meat production present on Brazilian market.

Key Words: Cuts Yield, Meat Quail, Slaughter

W198 Effects of genotype and plane of nutrition on performance and carcass composition of guinea fowl (*Numida meleagris*) broilers raised in the tropics. V. Díaz*, H. L. Santiago, and A. A. Rodríguez, *University of Puerto Rico*, *Mayagüez, Puerto Rico*.

Genetic selection of guinea stocks has improved production efficiency but studies directed to evaluate the nutritional requirements of new genotypes are limited. A total of 675 keets from three genotypes diverging in their genetic background; a native genotype (NG) and two commercial genotypes (CG1, CG2) were raised under three feeding regimes to market age. The three experimental diets provided a low

(LPN), intermediate (IPN), and a high (HPN) plane of nutrition based on the CP and ME of diets. Birds and feed were weighed at the end of the starter (35 d), grower (63 d), and finisher (84 d) periods to obtain body weight (BW), feed intake (FI), and feed conversion (FC). At 84d, 35 birds per treatment were randomly selected and processed to evaluate carcass composition. The weights of New York dressed (NYD), ready to cook (RTC), and fat pad (FP) were obtained and yields calculated as a percentage from live BW. A significant main effect of genotype for BW was found at 35, 63, and 84 d where both CG birds had similar but significantly heavier BW than NG birds. A significant effect of diet was observed at 35 and 84 d, where birds fed HPN diets had significantly heavier BW weights than those fed IPN and LPN diets. At all ages, CG1 and CG2 had similar but significantly lower FC compared to NG. However, no significant differences were observed for FI. There was a significant genotype and plane of nutrition interaction where birds of the CG1 fed HPN and IPN diets and CG2 fed IPN diet had significantly heavier NYD and RTC weights. Carcass RTC yields of CG were significantly higher compared to NG birds. Guineas of the NG had significantly lower percentage of FP than both CG evaluated. Birds raised under a HPN and IPN regime had significantly FP yield than those raised under a LPN regime. This investigation confirms that genetic selection has made significant improvements on performance and carcass traits of guinea broilers. The results showed that improvements in performance traits and processing yields may be obtained when CG are raised under a HPN regime.

Key Words: Guinea, Genotype, Nutrition

Physiology & Endocrinology - Livestock and Poultry: Reproductive Physiology

W199 Influence of post-AI nutrition on blood urea nitrogen, progesterone, and pregnancy. G. A. Perry*, B. L. Perry, J. R. Nelson, and J. A. Walker, *South Dakota State University*, *Brookings*.

Research has shown that changes in nutrition can have an effect on reproductive performance. Our objective was to determine the effect of post-AI nutrition on BCS, blood urea nitrogen (BUN), progesterone, and pregnancy rates. Forage-developed Angus-cross heifers (n = 336) were synchronized with the Select Synch+CIDR protocol (d -7 100 µg GnRH and CIDR; d 0 25 mg PG and removal of CIDR; Estrus detected for 72 h and heifers bred 12 h after detection in estrus; heifers not in estrus were bred with an injection of GnRH at 72 h). Each breeding period was equally divided into three treatments: 1) heifers returned to feedlot (LOT), 2) heifers were moved to pasture (PASTURE), or 3) heifers were moved to pasture and supplemented with 2.22 kg/hd/d of dried distillers grains plus solubles (SUPP). Blood samples were collected on d -7, 0, 2, 14 and 42 (pregnancy determination; analyzed by repeated measures). BCS were determined on d -7 and 42. All heifers were in similar ($P = 0.78$) BCS (5.4 ± 0.05) on d -7, but on d 42 SUPP (5.9 ± 0.04) were in greater condition ($P < 0.01$) than LOT (5.8 ± 0.04) which were in greater condition ($P < 0.01$) than PASTURE (5.4 ± 0.04). All treatments had similar ($P > 0.14$) BUN concentrations on d -7 (129 ± 1), but on d 2, 14 and 42 SUPP had greater ($P < 0.01$) BUN concentrations compared to both LOT and PASTURE. There was no difference in BUN concentrations between pregnant and open heifers ($P = 0.37$). Progesterone concentrations were similar among all heifers ($P \geq 0.05$) on d 0 and 2. SUPP had greater progesterone on d 14 ($P = 0.02$) compared to LOT, and on d 14 and 42 PASTURE had greater progesterone ($P < 0.02$) compared to LOT. Progesterone was similar ($P > 0.16$) for open and pregnant heifers on d 0 and 2, but greater ($P < 0.04$) in pregnant heifers on d 14 and 42. There was no difference among treatments in pregnancy rates ($P > 0.64$; 57, 56, and 59% for SUPP, LOT, and PASTURE; analyzed by chi-square). In summary, supplementing forage-developed heifers after insemination increased BCS and BUN concentrations, but had no effect on pregnancy rates.

Key Words: Heifers, Fertility, Post-AI Nutrition

W200 Effect of dietary ω-3 polyunsaturated fatty acid supplementation on hormone and metabolite concentrations and corpus luteum size in beef heifers. S. Childs*[1,2], J. M. Sreenan[1], A. A. Hennessy[3], C. Stanton[3], M. G. Diskin[1], and D. A. Kenny[2], [1]*Teagasc Animal Production Research Centre*, *Athenry, Co. Galway, Ireland*, [2]*University College*, *Dublin, Ireland*, [3]*Teagasc Moorepark Food Research Centre*, *Co. Cork, Ireland*.

Supplementation of cattle diets with fishoil has been reported to improve fertility. Though the mechanisms involved remain unclear, it is thought that constituent ω-3 polyunsaturated fatty acids (ω-3 PUFA) eicosapentaenoic (EPA) and docosahexaenoic (DHA) acids may mediate this effect. The objective of this study was to examine the effect of level of a high ω-3 PUFA product on a number of important reproductive variables. Heifers (n=40) were randomly assigned to a concentrate and straw (80:20) based ration supplemented with one of four levels of a high ω-3 PUFA product to provide on a DM basis: (1) 0g (**C**); (2) 62g (**T2**); (3) 129g (**T3**) or (4) 273 g (**T4**) of EPA and DHA combined. Diets were offered for 45 days and were isolipid and isonitrogenous. Heifers were oestrous-synchronised and plasma samples were collected to determine progesterone (P_4) and oestradiol (E_2) concentrations on day of oestrus (0) and on days 4, 7, 10, 14 and 16 post oestrus. Corpus luteum (CL) size was measured on day 7. Samples for fatty acids (FA) and cholesterol analysis were collected on day 16. FA methyl esters were separated by gas chromatography. P_4 and E_2 were measured by RIA. Data were analysed using repeated measures ANOVA. There was a positive linear effect of dietary ω-3 PUFA on plasma EPA ($P<0.0001$) and both positive linear ($P<0.01$) and quadratic ($P<0.05$) components to the effect on plasma DHA. Plasma cholesterol was similar for C, T2 and T3, and higher ($P<0.05$) for T4 compared with C or T2. There was no effect of treatment ($P>0.05$) on E_2. CL diameter was greater ($P<0.05$) on T3 and T4 than C or T2. On day 14, P_4 concentrations were higher on T4 than on C and T2 ($P>0.01$) but did not differ between other treatment comparisons ($P>0.05$). Omega-3 PUFA supplementation may increase P_4 concentrations around the critical period of maternal recognition of pregnancy. This increase may be mediated through increased substrate availability and/or CL size.

Key Words: Omega-3 PUFA, Reproductive Hormones, Fertility

W201 Effect of level of dietary supplementation on concentrations of eicosapentaenoic acid (EPA) and docosahexaenoic acid (DHA) in selected tissues in cattle. S. Childs*[1,2], J. M. Sreenan[1], A. A. Hennessy[3], C. Stanton[3], and D. A. Kenny[2], [1]*Teagasc Animal Production Research Centre*, *Athenry, Co. Galway, Ireland*, [2]*University College*, *Dublin, Ireland*, [3]*Teagasc Moorepark Food Research Centre*, *Co Cork, Ireland*.

Increased intake of omega-3 polyunsaturated fatty acids (ω-3 PUFA) has been suggested to improve fertility in cattle. However, as long-chain PUFA are extensively hydrogenated in the rumen, this often results in poor transfer from diet to tissue. The objective of this study was to examine the effect of level of dietary ω-3 PUFA supplementation on concentrations of both EPA and DHA in blood plasma (PL), rumen fluid (RF), follicular fluid (FF) and uterine endometrial tissue (ET) in cattle. Heifers (n=40) were randomly assigned to a concentrate and straw (80:20) based ration supplemented with one of four levels of a partially rumen-protected high ω-3 PUFA product to provide on a DM basis: : (1) 0g (**C**); (2) 62g (**T2**); (3) 129g (**T3**) or (4) 273 g (**T4**) of EPA and DHA combined. Diets were offered on an individual basis and were isolipid and isonitrogenous. Heifers were slaughtered after 45 days on experiment. Blood samples for PL were collected on day 44 and RF, FF and ET samples were collected immediately post-slaughter for fatty acid analysis. Data were analyzed using ANOVA and multiple regression analyses. There was a positive linear effect of treatment on concentrations of EPA in PL ($P<0.0001$), FF ($P<0.05$) and ET ($P<0.0001$) but no effect in RF ($P>0.05$). There was a positive linear ($P<0.01$) effect of treatment on DHA concentrations in RF with a tendency towards a quadratic component ($P=0.07$). The effect of diet on PL and FF concentrations of DHA was positive with both linear ($P<0.01$) and quadratic ($P<0.05$) components while the effect on ET concentration was both positive and linear in direction ($P<0.05$). Blood plasma concentrations of EPA ($R^2=0.69$) and DHA ($R^2=0.28$) were the best predictors of their respective concentrations in ET. Tissue concentrations of ω-3 PUFA can be manipulated through rumen protection of dietary supplements. Blood plasma concentration may be a useful predictor of PUFA concentration in reproductive tissues.

Key Words: Omega-3 PUFA, Rumen Protection, Reproductive Tissue

W202 Nutritional and genetic effects on the follicular growth of the Nelore-Hereford heifers. J. O. J. Barcellos*, E. R. Prates, J. López, and J. Braccini, *Federal University of Rio Grande do Sul*, *Porto Alegre- RS - Brasil*.

The objective of this study was to evaluate the effects of growth rate during the post-weaning phase to puberty on the follicular growth of the two hundred beef heifers Nellore-Hereford crosses. The heifers were weaned in the six months old and allotted in the factorial experimental design 4 (weight gain daily) × 5 (crossbreed degree-CX) and treatments were: 50 heifers (25%N-75%H; 37.5%N-63.5%H; 43.7-56.3%H; 50%N-50%H and 75%N-25%H) submitted to an average growth rate (AGD) of 0.500 kg/day (G500); 50 heifers (25%N-75%H; 37.5%N-63.5%H; 43.7-56.3%H; 50%N-50%H and 75%N-25%H) with an ADG of 0.750 kg/day (G750); 50 heifers (25%N-75%H; 37.5%N-63.5%H; 43.7-56.3%H; 50%N-50%H and 75%N-25%H) with an ADG of 1.000 kg/day (G1000) and 50 heifers (25%N-75%H; 37.5%N-63.5%H; 43.7-56.3%H; 50%N-50%H and 75%N-25%H) with an ADG of 1.250 kg/day (G1250). The experimental diets were adjusted to achieve at puberty an 12-13 months of age. The diameter of the large follicle (DLF- mm) and the follicular area total (FA- mm2) at the 10, 11 and 12 months of age by real-time ovarian ultrasonography Aloka SD500 model, in the total heifers were evaluated. The data were analyzed by ANOVA and stepwise regression. The average age at puberty was at 338 ± 22 days. The general equation by DLF at 10 months were DLF=8.642*ADG-3.3615 (r2=0.70). At the 10 months, the results showed an interaction ($P<0.01$) between the ADGxCX with the higher effect of the ADG on the DLF in the heifers with minus of the 50%N. The effects of the nutritional levels were similar at 11 and 12 months ($P>0.06$). However, the G1250-75N showed higher variations ($P<0.05$) on the DLF from the 10 to 12 months (4.5mm × 10.6mm) than heifers 25, 35.5, 43.7 and 50% ones. The heifers 25, 35.5 and 43.7%N showed higher AF at 10, 11 and 12 months age and the effect were very important in the G1000 and G1250 ($P<0.01$). Therefore, the weight gain posweaning have the effect important on the follicular growth to puberty early in crossbreed heifers.

Key Words: Puberty, Beef Cattle, Reproduction

W203 Levels of serum progesterone in creole cows with and without corpus luteum treated with CIDR®, progesterone, β-estriadiol and $PGF_{2\alpha}$. J. P. Zarate Martinez*, J. A. Ramirez Godinez, and F. A. Rodriguez Almeida, *Universidad Autonoma de Chihuahua*, *Chihuahua, Chih. Mexico*.

Experiments were conducted to study the serum progesterone (P_4) levels in cows with ($P_4 \geq 1$ ng/mL) and without corpus luteum (CL), treated with two hormone protocols that used an intravaginal CIDR® device. Cows were assigned randomly to one of two treatments (T). T1 (n=14) received a CIDR® with 1.9 g of P_4 + IM injection of 1 mg β-estriadiol and 50 mg of P_4, and CIDR® was withdrawn on day 7, when an IM injection of 30 mg of $PGF_{2\alpha}$, and on day 8 1 mg IM of β-estriadiol was administered; T2 (n=13) was similar but IM injection contained 1 mg of β-estriadiol without P_4. To determine the concentrations of P_4, blood samples were taken on days (D) 0, 1, 2, 7, 8, and 9 after application of CIDR®. Serum concentrations were analyzed with PROC MIXED of SAS, adjusting a model with main effects of CL, T, D and their interactions, and random effects of cows within T*CL. Seventy-five percent of cows exhibited estrus. There were no differences ($P>0.05$) for P_4 concentrations between T1 (5.63±0.497 ng/mL) vs T2 (4.51±0.486 ng/mL). The presence of a CL at the beginning of hormone application protocols was not significant ($P>0.05$) for the average concentrations of P_4 in cows with CL (5.85±0.36 ng/mL) and cows without CL (4.31±0.59 ng/mL) during the days of treatment. The interaction T*D showed numerical differences in the P_4 concentrations. There were differences between T1 (10.90±0.921 ng/mL) and T2 (7.46±1.054 ng/mL) on day 1 and this trend continued until CIDR® was withdrawn; however differences were not significant ($p>0.05$). Higher values of P_4 concentrations for T1 cows, which received an IM injection of 50 mg of P_4 besides the CIDR®, than for T2 cows, which did not received P_4 injection, were as expected; however more observations are needed to confirm findings.

Key Words: Creole Cows, CIDR, Corpus Luteum

W204 Effect of progestin treatment on formation of persistent follicles in beef heifers. M. E. Heaton*, J. A. Atkins, J. F. Bader, C. L. Johnson, and M. F. Smith, *University of Missouri*, *Columbia*.

Effective estrous synchronization protocols frequently utilize progestins (melengestrol acetate [MGA] and Controlled Internal Drug Release [CIDR] inserts) to synchronize estrus. Previous research demonstrated that long-term treatment with MGA, in the absence of a corpus luteum, caused formation of persistent follicles and resulted in low fertility. The specific aims of this project were to determine if the presence of a new or used CIDR, in heifers without a corpus luteum, would induce the formation of persistent follicles and to compare the pattern of serum concentrations of progesterone in heifers treated with a new or used CIDR to luteal phase concentrations of progesterone (P4) in non-treated heifers. Normally cycling heifers were allocated by age, weight, and breed into four treatment groups: Control (n=8), MGA (n=4; 0.5 lbs-1hd-1day), new CIDR (n=7; 1.38 g P4), and used CIDR (n=8; new CIDR's previously inserted into cows for 7 d). Progestin treatment (MGA or CIDR) began on d 4 post-estrus and PG was injected on d 6 to induce luteolysis (d 0 = estrus). MGA or CIDR treatment continued for 14 d and length of a follicular wave was defined as the interval from follicular recruitment to ovulation or initiation of a new wave. Length of the first follicular wave (d) was 10.9^{a}, 18.0^{b}, 17.1^{b}, and 16.9^{b} ($^{ab}P \leq .05$) and maximum diameter (mm) of the dominant follicle was 14.4^{c}, 18.8^{d}, 16.0^{c}, and 18.5^{d} (Control, MGA, new CIDR, and used CIDR, respectively; $^{cd}P \leq .06$). Dominant follicle diameter was greater ($P \leq .05$) in the used CIDR group compared to the new CIDR group after d 10 of treatment but similar to the MGA group. Serum concentrations of progesterone in the new and used CIDR groups were similar ($P \geq .05$) throughout the 14 d treatment period but lower than in the control group. In summary, treatment with a new or used CIDR induced formation of persistent follicles in beef heifers and there was no difference in serum concentrations of progesterone between the two CIDR groups.

Key Words: Progesterone, Persistent Follicle, Estrous Synchronization

W205 Relationships between cortisol concentrations and cow temperament with calf exit velocity from 3 weeks of age through weaning. N. C. Burdick*[1], R. D. Randel[2], J. P. Banta[2], D. A. Neuendorff[2], J. C. White[2], J. G. Lyons[3], T. H. Welsh, Jr.[3], R. C. Vann[4], and J. C. Laurenz[1], [1]*Texas A&M University-Kingsville*, *Kingsville*, [2]*Texas A&M University Agricultural Research and Extension Center*, *Overton*, [3]*Texas A&M University*, *College Station*, [4]*Mississippi State University*, *Raymond*.

The relationship between cortisol concentrations and cow temperament with exit velocity (EV) in Brahman calves from 3 weeks of age through weaning was assessed. Blood samples were collected from calves (n=116) and their dams on d21-to-24 after birth and from the calves at weaning. Serum concentrations of cortisol (CS) were determined by RIA. Calf EV was determined on d21-to-24 of age and at 28-d intervals until weaning (d173±2) as a measure of temperament. Calves were ranked based on their EV on d21-to-24 (EV Rank) with calves 1 SD slower than the mean ranked 1 (calm; n=17), calves 1 SD faster than the mean ranked 3 (temperamental; n=19), and remaining calves ranked 2 (intermediate; n=80). A subjective measurement of cow temperament was assessed by individual observer with cows being ranked as calm, intermediate, or temperamental. Temperamental cows had greater concentrations of CS (7.2±0.7; $P<0.01$) than calm (3.9±0.4) and intermediate cows (4.2±0.3). Cow CS concentrations were not associated with calf CS concentrations early in life (d21-to-24; $P=0.91$) or at weaning ($P=0.63$). Cow temperament did not affect calf EV from d21-to-24 to weaning ($P=0.39$). However, calf EV was affected by calf EV Rank on d21-to-24, with temperamental calves having a greater EV (3.0±0.12; $P<0.01$) at all ages when compared with calm (1.7±0.2) and intermediate calves (2.1±0.1). Also, calf CS concentrations on d21-to-24 were associated with calf EV Rank on d21-to-24, with temperamental calves having greater concentrations of CS (5.2±0.8; $P<0.01$) when compared to calm (3.0±0.4) or intermediate calves (3.6±0.2). Calf CS at weaning, however, was not related to calf EV Rank on d21-to-24 ($P=0.22$), although temperamental calves had numerically greater concentrations than calm or intermediate calves. Collectively, these data suggest that although cow temperament is related to cow CS concentrations, and calf EV is associated with calf CS, calf EV is not affected by cow temperament. Calm and intermediate calf EV increased through d67 of age before reaching a plateau, while the EV of temperamental calves displayed little change over time.

Key Words: Temperament, Cortisol, Calves

W206 Microbial flora of normal and abnormal cervical mucous discharge associated with reproductive performance of cows and heifers in estrus. A. Ata, H. Turutoglu, M. Kale, M. S. Gulay*, and F. Pehlivanoglu, *Mehmet Akif Ersoy University*, *Burdur, Turkey*.

The aim of the present study was to describe whether abnormal cervical mucus discharge (A-CMD) or pathogens such as aerobic bacteria and fungi in cervical mucus discharge (CMD) have effects on reproductive performance (RP) of cows and heifers in estrus. For this purpose, CMD of 222 animals in estrus were evaluated visually before artificial insemination (AI). Animals having clear discharges (68 cows, 38 heifers) with normal viscosity and without bad odor were grouped as normal cervical mucous discharge (N-CMD) group. The other animals (84 cows, 32 heifers) were grouped as A-CMD group. CMD samples were submitted to cultural examination for *Campylobacter spp.*, *Brucella spp.*, aerobic bacteria and fungi. Microorganisms isolated from samples were divided three groups as uterine pathogens (UP), potential uterine pathogens (PUP) or opportunistic uterine pathogens (OUP). Presence of PUP was associated with A-CMD for both cows ($P<0.01$) and heifers ($P<0.02$). First service conception rates (FS-CR) were lower in cows positive for PUP ($P<0.01$). Moreover, presence of PUP and OUP affected FS-CR in heifers ($P<0.01$). Although A-CMD significantly affect FS-CR in cows ($P<0.04$), it did not affect FS-CR in heifers. Differences in average open day (OD) for cows and first service age (FSA) for heifers were significant between N-CMD ($P<0.02$) and A-CMD ($P<0.01$) groups, respectively. Our findings indicated that pathogens have a negative effect on reproductive performance of cows and heifers when it changes to appearance of CMD.

Key Words: Cervical Mucous Discharge, Reproductive Performance, Bacteria-Fungi

W207 *In vitro* production of bovine embryos in chemically defined serum-free media. A. Dhali, V. M. Anchamparuthy, S. P. Butler, R. E. Pearson, and F. C. Gwazdauskas*, *Virginia Polytechnic Institute and State University*, *Blacksburg*.

Embryo production and culture in serum supplemented media is a common practice. Nevertheless, several studies indicate the need to develop suitable serum-free conditions for *in vitro* embryo production and culture as serum can inhibit embryo development and can alter morphological and chemical properties of embryos. Moreover, *in vitro* embryos generated under chemically defined conditions can serve as a valuable model in many research applications. The objective was to develop a complete chemically defined serum-free system for in vitro production and culture of bovine embryos. Abattoir-derived oocytes were matured in TCM-199 supplemented with LH (0.02 U/mL), FSH (0.02 U/mL), estradiol (1 µg/mL) and BSA. The swim-up separation of motile spermatozoa for *in vitro* fertilization (IVF) was performed in BSA supplemented HEPES buffered synthetic oviductal fluid (SOF). Matured oocytes were fertilized in BSA supplemented SOF-IVF medium and presumptive zygotes were cultured for 8 d (in a humidified 5% CO_2 atmosphere at 38.5°C) in BSA supplemented SOF-in vitro culture (IVC) medium containing either epidermal growth factor (EGF, 10 ng/mL), stem cell factor (SCF, 50 ng/mL), or IGF-1 (100 ng/mL). Control embryos were cultured in BSA and fetal calf serum (FCS) supplemented SOF-IVC medium. The cleavage rate did not vary significantly among the treatments and control (EGF: 77.6%, SCF: 68.3%, IGF-1: 73.4% and FCS: 72.8%). Similarly, the blastocyst (EGF: 22.7%, SCF: 24.6%, IGF-1: 26.0%, FCS: 35.2%) and expanded blastocyst (EGF: 10.6%, SCF: 12.7%, IGF-1: 16.5% and FCS: 22.7%) formation rates based on total number of oocytes did not differ significantly among the treatments and control. In conclusion, an acceptable level of embryonic development could be achieved using the serum-free chemically defined conditions and growth factor supplementation in the culture medium.

Key Words: Embryo, Bovine, Serum-free Media

W208 Droplet vitrification method did not induce cytoskeletal damage in mouse embryos. A. Dhali, V. M. Anchamparuthy, S. P. Butler, R. E. Pearson, and F. C. Gwazdauskas*, *Virginia Polytechnic Institute and State University*, *Blacksburg*.

The concept of ultra rapid vitrification has been emerging in recent years. This particular process increases cooling and warming rates that provide the opportunity to reduce cryoprotectant concentrations in vitrification solutions and reduce cytotoxicity. The objective was to document embryo survival and cytoskeletal damage when mouse embryos were vitrified using a modified ultra rapid vitrification method, the droplet vitrification. Mouse embryos (zygotes, 2-cell and morulae) were initially equilibrated for 3 min in 50% vitrification solution and then quickly washed 3 times in vitrification solution (17.5% ethylene glycol (EG), 17.5% DMSO, 0.5M sucrose and 4 mg/mL BSA in M2 medium). Subsequently a drop (5µL) of vitrification solution containing 10 to 12 embryos was formed, placed directly onto liquid nitrogen and liquid nitrogen was poured immediately over the drop. Warming and removal of cryoprectants were performed by placing the vitrified drop into dilution medium (0.3M sucrose and 4 mg/mL BSA in M2 medium) for 3 min and then into M2 medium for 5 min. Following vitrification, warming and culture, 57.9% of pronuclear stage, 59.2% of 2-cell stage and 86.3% of morulae developed into blastocysts. The corresponding figures for hatched blastocyst were 37.8, 40.7 and 73.5%, respectively. Still, the development of control embryos into blastocyst (70.2% of pronuclear stage, 75.5% of 2-cell stage embryos and 91.5% of morulae) and hatched blastocyst (58.5% of pronuclear stage, 62.9% of 2-cell stage and 77.7% of morulae) was significantly ($P < 0.05$) higher. Laser scanning confocal microscopy revealed no actin cytoskeletal damage in any of the 3 stages of mouse embryos either after vitrification and warming or following the development into blastocyst. The study reveals that droplet vitrification is an easy and potentially ultra rapid vitrification method, which may be utilized to preserve oocytes and embryos of other species as well.

Key Words: Embryo, Cytoskeleton, Vitrification

W209 Association of oviductal fluid (ODF) proteins with the bovine zona pellucida. E. Monaco*[1], B. Gasparrini[2], L. Boccia[2], A. De Rosa[2], L. Attanasio[2], G. Campanile[2], and G. Killian[1], [1]*The Pennsylvania State University*, *State College*, [2]*Federico II University*, *Naples, Italy*.

The objective of this study was to determine using confocal microscopy whether bovine serum albumin (BSA), osteopontin (OPN) and lipocalin-type prostaglandin D synthase (L-PGDS) were associated with the bovine zona pellucida (ZP) of immature bovine oocytes and after in vitro matured oocytes were incubated in ODF. Ampullary (A) and isthmic (I) non luteal (NL) ODFs from two Holstein cows were used. To investigate if BSA, OPN, L-PGDS bind to the ZP alone or to cumulus cells and plasma membrane, mature cumulus oocyte complexes, denuded and ZP-free mature oocytes were incubated in 1) TALP medium (without BSA, with 0.1% PVA) (control), 2) TALP medium and 50% ANL-ODF, 3) TALP medium and 50% INL-ODF. After 2.5 h the eggs were washed and incubated for 1 h with primary antibodies against one of the three proteins, washed again and then incubated for 30 min with goat anti-rabbit FITC labeled secondary antibody. Immature denuded oocytes were incubated for 1 h in 1) TCM (control), 2) TCM and primary antibody to one of the three proteins and then for 30 min with FITC-labeled secondary antibody. In all cases, the ZP of mature denuded eggs probed with primary and secondary FITC labeled antibodies fluoresced when eggs were pre-exposed to either TALP medium alone or TALP medium and ANL/INL-ODF. In no case did the cumulus cells or the plasma membrane have an affinity for any of the three proteins. However, L-PGDS distribution differed from that of BSA and OPN in that it was detected in the perivitelline space. These studies suggest the presence and in vivo binding of these proteins to the eggs before they reach the oviduct. Because the ZP of immature denuded oocytes incubated in TCM and probed with primary and secondary FITC labeled antibodies also fluoresced like the mature eggs, we suggest that BSA, OPN and L-PGDS are first acquired by the ZP from follicular fluid during follicular development. (USDA grant 2004-34437-15106).

W210 Decreased pulsatile LH secretion does not affect the function of the corpus luteum of pregnancy in cattle. H. T. Toriz*, H. Basurto, A. A. Porras, and C. G. Gutierrez, *Facultad de Medicina Veterinaria. UNAM*, *Mexico DF, Mexico*.

The objective of this study was to determine the corpus luteum (CL) dependence of pulsatile LH secretion in pregnant cattle. Twelve cows

with 90 days of pregnancy were either used as controls (n=6) or treated chronically with a GnRH agonist (n=6) (Buserelin; Hoechst Marion Roussel Ltd.). The chronic treatment with GnRHa was given with Buserelin acetate released continuously at 2.5 µg/h by an Alzet osmotic. This treatment has been previously shown to block LH pulses (Gong et al, 1996). The pump was replaced every 28 days with a new pump throughout gestation. Cattle were bled twice weekly from day 90 of to day 150 of gestation and every fortnight thereafter until parturition. The ability of the pituitary from the control and GnRHa treated cows to release LH was tested forty days after the start of the study (aprox. day 130 of gestation) by injecting them with 50ug of buserelin. Progesterone and LH were measured by RIA. All cows continue their pregnancy and calved normally. After the first GnRHa pump was inserted, treated cows developed a secondary CL. Progesterone concentrations were higher ($p<0.05$) in the GnRHa treated cattle (12.8 ng/ml) than in the control group (8.8 ng/ml) throughout the remaining of pregnancy. In the control group, all cows responded with LH release (≥ 4 ng/ml) after the buserelin challenge. However, LH released was significantly reduced ($p<0.01$) by GnRHa chronic treatment. The results of this study suggest that the corpus luteum of pregnancy does not depend on pulsatile release of LH for its maintenance and function.

Key Words: Corpus Luteum, Luteinizing Hormone, Pregnancy

W211 Protective effects of the antioxidant dithiothreitol (DTT) on preimplantation bovine embryos exposed to heat shock. L. A. de Castro e Paula* and P. J. Hansen, *University of Florida*, *Gainesville*.

Effects of heat shock (HS) on bovine embryos are greater in culture under high oxygen (20.95%) when compared to low oxygen (5%). It was hypothesized that HS effects involve reactive oxygen species (ROS) and DTT reduces these effects. For Experiment (Exp) 1 (culture in high oxygen), two-cell embryos were cultured at 38.5°C (control) or 41°C (HS) for 15 h with 0, 50 or 500 µM DTT. Embryos were then cultured at 38.5°C for 9 h in the same DTT treatment (trt) and then at 38.5°C without DTT until day 8. DTT increased the percent of control embryos becoming blastocysts ($P<0.05$) and heat shock reduced blastocyst development ($P<0.05$). This reduction was less for embryos treated with 500 µM DTT ($P<0.05$). For Exp 2, two-cell embryos were cultured at 38.5°C or 41°C for 15 h in high or low oxygen and with 0 or 500 µM DTT. Embryos were then cultured at 38.5°C for 9 h in either high or low oxygen in the same DTT trt and then cultured in low oxygen at 38.5°C without DTT until day 8. HS decreased blastocyst development in all trts except for the 0 µM DTT group cultured in low oxygen (temp × DTT; $P<0.05$). For Exp 3 (culture in high oxygen), embryos ≥16 cells were cultured at 38.5°C or 41°C for 15 h in the presence of 0, 50 or 500 µM DTT. Embryos were then cultured at 38.5°C for 9 h in their same DTT trts and then at 38.5°C without DTT until day 8. DTT increased the percent of control embryos becoming blastocysts ($P<0.05$). HS reduced blastocyst development ($P<0.05$) but the reduction was less for embryos treated with DTT ($P<0.05$). Exp 4 was conducted as for Exp 3 except that embryos were fixed 24 h after start of HS and analyzed by TUNEL assay. The percent of TUNEL-positive cells was increased by HS in the absence of DTT ($P<0.05$) but not in the presence of 50 or 500 µM DTT ($P>0.1$). In summary, DTT improved development of embryos cultured in high oxygen and conferred partial protection from HS. Protection was incomplete and it is likely that there are ROS-independent actions of HS. Since DTT was detrimental to HS embryos in low oxygen, there may be a ROS-dependent thermoprotective mechanism deployed by the embryo in low oxygen.

Key Words: Embryo, Heat Shock, Antioxidant

W212 Nylon mesh vitrification for cryopreservation of bovine oocytes. V. M. Anchamparuthy*, A. Dhali, S. P. Butler, R. E. Pearson, and F. C. Gwazdauskas, *Virginia Polytechnic Institute and State University*, *Blacksburg*.

Cryopreservation of oocytes is a challenge. The objective was to vitrify large numbers of cumulus intact bovine oocytes obtained from follicles of different diameter, ≤ 4 mm (Small) and 4 to 10 mm (Medium), after 15 h of in vitro maturation. Vitrification-warmed oocytes were in vitro fertilized using frozen semen from 2 bulls (Bull I and II). After maturation oocytes were first immersed in cryoprotectants consisting of 10% (v/v) ethylene glycol (EG), 4.5% (w/v) Ficoll-70 (F-70) and 0.075 M sucrose in Ca++ free PBS for 7 min followed by immersion in a solution consisting of 20% (v/v) EG, 9.0 % (w/v) F-70 and 0.15 M sucrose for 2 min, and finally in a solution of 40% (v/v) EG, 18% (w/v) F-70 and 0.3 M sucrose for 1 min. After equilibration, 15 to 20 oocytes were loaded onto nylon mesh, transferred to 2 mL pre-cooled cryovials, and directly plunging into liquid nitrogen. Thawing was conducted with a sequential series of 0.5, 0.25 and 0.125 M sucrose dilutions for 1, 2, and 3 min, respectively. After thawing, the oocytes were placed into maturation medium for an additional 9 h. Thawing resulted in 97% morphological survival with intact cumulus cells in both populations of oocytes. There was a difference ($P < 0.05$) in development rates between vitrified and control groups (39.6 ± 0.02 and 59.8 ± 0.02%, respectively, for cleavage compared with 6.5 ± 0.01 and 21.2 ± 0.01%, respectively, for blastocysts). Cleavage and blastocyst rates in oocyte populations from Small and Medium follicles were different ($P < 0.05$; 45.4 ± 0.02 and 53.9 ± 0.02% for cleavage; 11.6 ± 0.01 and 16.1 ± 0.01% for blastocyst, respectively). Sire did not affect cleavage rate ($P > 0.05$; 49.6 ± 0.02), but had an effect ($P < 0.05$) on blastocyst rate (10.0 ± 0.01 for Bull I vs. 17.8 ± 0.01% for Bull II). Our results show that nylon mesh is a useful method for vitrification of large numbers of matured bovine oocytes.

Key Words: Bovine, Vitrification, Oocyte

W213 Follicle numbers on the ovaries of cows selected for high and low IGF. L. Snellgrove[1], T. A. Hoagland*[1], G. W. Kazmer[1], M. E. Davis[2], D. Schrieber[1], and S. A. Zinn[1], [1]*University of Connecticut*, *Storrs*, [2]*The Ohio State University*, *Columbus*.

Post-partum lactating Angus beef cows (n = 10) divergently selected for greater (H; n = 6) or lesser (L; n = 4) IGF-I concentrations were subjected to rectal palpation and ultra-sonography to determine the influence of this divergent selection for IGF on follicular dynamics. Beef cows treated with bST have greater numbers of small and medium follicles. With these genetically diverse cows, the role of IGF on follicular development could be investigated. The cows were subjected to rectal examinations twice per week between 30 and 80 d post-partum. The number of follicles on each ovary were determined and classified as small (1 to 3mm), medium (4 to 6mm) or large (< 6mm). In addition, presence of corpora lutea, and length and width

of the ovaries were recorded. Total number of small, medium and large follicles were greater (P = 0.0068) in H IGF cows compared with L IGF cows. The H IGF group averaged 10.9 ± 0.76 follicles compared with the L IGF group which averaged 6.56 ± 0.93 follicles. On the right ovary, the number of small (3.87 ± 0.45 vs. 2.12 ± 0.55; P = 0.0389) and medium (1.28 ± 0.15 vs. 0.66 ± 0.18; P = 0.0284) follicles were greater in H IGF cows than L IGF cows. Similarly, on the left ovary, the number of medium follicles was greater (P = 0.046) in the H cattle (1.63 ± 0.21) compared with L cattle (0.84 ± 0.26); and the number of small follicles were greater at the P = 0.12 level in H (2.9 ± 0.35) then L (2.0 ± 0.42) cows. The average ovarian volume (4.8 ± 1.0 cc) or the number of large follicles (0.64 ± 0.1) on either the right or left ovary in the H or L IGF selected cows were not different (P < 0.12). In conclusion, cows selected for greater IGF had more follicles than cows selected for low IGF indicating that divergent selection for IGF subsequently plays a role in follicular recruitment.

Key Words: IGF, Beef Cows, Follicles

W214 Effect of insulin-like growth factor-1 during culture on blastocyst mRNA abundance and survival in utero to day 14 of bovine embryos produced in vitro. J. Block*[1], C. Wrenzycki[2], D. Herrman[2], T. M. Rodina[1], H. Niemann[2], A. D. Ealy[1], A. E. Fischer-Brown[3], and P. J. Hansen[1], [1]*University of Florida*, *Gainesville*, [2]*Institute for Animal Science*, *Neustadt, Germany*, [3]*University of Illinois*, *Urbana*.

Transfer of bovine embryos cultured with insulin-like growth factor–1 (IGF–1) can increase pregnancy rates in heat-stressed, lactating dairy cows. Two experiments were conducted to determine the effect of IGF–1 on the relative abundance of several developmentally important genes as well embryo survival to day 14 of gestation. In experiment 1, embryos were produced in vitro (n = 4 replicates) and cultured with or without 100 ng/mL IGF-1 for seven days. On day 7, grade 1 expanded blastocysts (n = 104 control and 96 IGF–1, respectively) were selected for semi-quantitative reverse transcription-polymerase chain reaction analysis. Treatment with IGF–1 increased (P < 0.02) the relative abundance of IGF binding protein 3 and desmocollin II and tended (P < 0.08) to increase sodium/potassium ATPase and Bax. In contrast, IGF–1 decreased (P < 0.05) the relative abundance of heat shock protein–70 and tended (P < 0.08) to decrease IGF-1 receptor. In experiment 2, non-lactating (n = 52) and lactating (n = 32) Holstein cows were selected as recipients following synchronization for timed-embryo transfer (n = 11 replicates). Embryos were produced as described in experiment 1. At Day 7 after anticipated ovulation (Day 0), a single embryo was randomly transferred to each recipient. Embryos were recovered at Day 14 and embryo length was recorded. Recovered embryos were cultured for 24 h and interferon-τ (IFN-τ) secretion was assessed using an anti-viral assay. Recovery rate at Day 14 for recipients that received IGF–1 treated embryos tended (P = 0.10) to be greater (16/37 = 43.2%) than for recipients that received control embryos (12/47 = 25.5%). However, there was no effect of IGF-1 on embryo length or IFN-τ secretion. Results indicate that IGF–1 treatment can alter the relative abundance of several developmentally important genes. Moreover, IGF–1 can increase embryo survival as early as day 14 of gestation. These effects may be important for the improved survival of IGF–1 treated embryos reported previously.

Key Words: Insulin-Like Growth Factor-1, Embryo, Bovine

W215 Effect of supplementation with Megalac-E on pregnancy rate in primiparous Nellore cows. C. N. Lopes[1], J. L. M. Vasconcelos*[1], T. P. B. Araujo[2], and L. O. F. Oliveira[3], [1]*FMVZ-UNESP*, *Botucatu, SP, Brazil*, [2]*Arm&Hammer*, *Brazil*, [3]*Propec Consultoria*, *Brazil*.

Fat supplementation has often positively influenced the reproductive status of the dairy cow. Linoleic acid is inhibitor of cyclooxygenase in endometrial tissue of dairy cows, which suppress endometrial secretion of PGF2α and potentially prevent early embryonic death (Staples et al, 1998). The objective was to evaluate effect of supplementation with Megalac-E® (40% linoleic acid; Arm&Hammer) on reproductive responses in primiparous Nellore cows after timed AI. The trial was conducted at a beef farm in Brazil from December 2006 to January 2007. Primiparous Nellore cows (n=411; 50 to 80 days post partum) received 0.4kg/day of concentrate plus minerals at pasture, from the beginning of the synchronization protocol until day 28 after timed AI and were randomly assigned to received or not the supplementation with Megalac-E: Control Group 100gr Kaolin (n= 211); Megalac Group 100 g Megalac-E (n= 200). Cows were synchronized with an intravaginal P4 device (CIDR®, Pfizer, Brazil) plus an injection of 2 mg of estradiol benzoate (Estrogin®, Farmavet, Brazil) on day 0. On day 9, 12.5 mg of dinoprost (Lutalyse®, Pfizer, Brazil) plus 0.5 mg of estradiol cipionate (ECP®, Pfizer, Brazil) were administered, CIDR® was removed, and the calves were removed until finishing TAI, that was performed 48 hours after CIDR® removal. Pregnancy rates were the percentage of cows diagnosed pregnant by ultrasonography (Aloka 500, probe 7.5 MHz) at Day 28 after TAI. Effects of treatment on pregnancy rates were analyzed by chi-square test. Pregnancy rates in the cows treated with Megalac-E (56.5%; 113/200) were higher (p=0.015) than in control group (45.6%; 94/211. The mechanism by which Megalac improves reproductive performance may be due to the Linoleic acid that has been demonstrated had inhibitory effect on the prostaglandin synthesis. This data suggests that Megalac-E at the beginning of the Timed AI protocol until day 28 after AI to lactating primiparous Nellore cows increased pregnancy rate, probably due its antiluteolytic effect.

Key Words: Conception, Megalac, Nellore Cows

W216 Progesterone postpartum determination and reproductive performance of crossbred cows. M. S. Arellano-Cornejo[1], J. C. Martinez-Gonzalez*[2], E. M. Romero-Trevino[1], F. Briones-Encinia[2], F. De la Garza-Requena[2], and M. Dominguez-Munoz[3], [1]*Instituto Tecnologico Superior de Altamira*, *Altamira, Tamaulipas, Mexico*, [2]*Agronomia y Ciencias, Universidad Autonoma de Tamaulipas*, *Ciudad Victoria, Tamaulipas, Mexico*, [3]*FMVZ, Universidad Autonoma de Tamaulipas*, *Ciudad Victoria, Tamaulipas, Mexico*.

This study was conducted to determine the effect of calving number (CN), body condition (BC), and days after calving (AC) on first progesterone postpartum rise (P4). Also first estrous postpartum (EP) and calving conception intervals (CC) were studied. Twenty one cows Brown Swiss × Zebu were divided into 4 groups according to CN: I) 3 (first-lactating); II) 9 (two calving); III) 7 (three calving), and IV) 2 (four calving). Cows grazed Cynodon nlemfuencis and Panicum maximum, and were protein supplemented (18% CP) with 2 kg/cow/d. Estrus was detected by daily visual observation at milking time and on pasture. Progesterone was determined by RIA, low plasma progesterone values (<0.5ng/mL) were consistent with ovarian inactivity, confirming

the true anestrus status of experimental animals. CC was confirmed by rectal palpation. BC was evaluated using a scale of 1 to 9, were 1 = very thin, and 9 = very fat. The study has duration of 60 days postpartum. The mean (P4P) was 1.07 ± 1.68 ng and were affected by BC and AC ($P < 0.001$). Cows with BC 3 and 4 failed to exhibit estrus and maintained low progesterone concentrations throughout the study (2.86, 1.89, 1.26, 0.61 and 0.04 ng for 7, 6, 5, 4 and 3 BC, respectively). The animals, high progesterone values from day 45 onwards suggested ovulatory estrus. It was concluded that BC and AC are the parameters that have more influence on ovarian activity ailed the duration of the anestrous postpartum period. To determine the factors that affect interval calving, it is necessary to study the overall herd fertility.

Key Words: Bovine, Progesterone, Anestrus

W217 Diagnosis of bovine freemartinism by fluorescence in situ hybridization using a bovine Y chromosome-specific DNA probe. S. H. Sohn, E. J. Cho, W. J. Son, and C. Y. Lee*, *Jinju National University*, *Jinju, Korea*.

A heifer born as a co-twin to a bull mostly becomes a sterile freemartin which needs to be screened out from the replacement stock during early development for efficient cattle production. Various methods are available for the diagnosis of freemartinism, but none of them are perfect in terms of the speed, sensitivity, or specificity. The present study was thus conducted to develop and validate a satisfactory fluorescence in situ hybridization (FISH) procedure for identifying the bovine XX/XY-karyotypic chimerism, the hallmark of the freemartinism. A FISH probe containing the 54-bp bovine male-specific BC1.2 DNA sequence was synthesized and labeled with digoxigenin by polymerase chain reaction. The FISH was performed on chromosome spreads and nuclei of blood lymphocytes on slides; karyotyping was done on the chromosome spread following G-banding. Upon FISH, the probe expectedly bound to the nucleus of the male cell or to a region of the Yp12 locus on the chromosome spread. Out of a total of 24 Holstein-Friesian and Korean Cattle heterosexual twins consisting of 13 heifers and 11 bulls which were analyzed in the present study, all but three exhibited the XX/XY-karyotypic chimerism to varying extents regardless of the breed or age of the animal in both FISH and karyotyping. One heifer was identified to have 100% XX-type cells by both analyses, whereas two bulls were judged as 100% XY- and XX/XY-chimeric karyotypes by karyotyping and FISH, respectively. Nevertheless, the ratios of the XY to XX cells in these two bulls and all the other animals were very similar between the two analyses. Results indicate that the present FISH is a rapid and reliable procedure which can be used for early diagnosis of bovine freemartinism.

Key Words: Freemartin, Karyotype, FISH

W218 Influence of insulin on plasma and hepatic composition, ovarian activity and estrous behavior in early lactation dairy cows. J. A. Casas*, M. F. Sa Filho, C. Narciso, F. Rivera, and J. E. P. Santos, *Veterinary Medicine Teaching and Research Center, University of California Davis*, *Tulare*.

Objectives were to determine the effects of increased plasma insulin under normoglycemia on blood and hepatic composition, ovarian activity and estrous behavior in dairy cows. Holstein cows at 1 d in milk (DIM) were randomly assigned to receive 0 (CON, n=38) or 75 IU of slow-release insulin (INS, n=38) and 30 g of glucose i.v. daily until 14 DIM. Ovaries were examined by ultrasonography 4 × weekly from 10 to 60 DIM. Estrous behavior was evaluated by a radiotelemetric heat mount device. Blood was sampled daily immediately before insulin injection in the first 14 DIM, and 4 × weekly thereafter. Plasma was analyzed for concentrations of glucose, insulin, nonesterified fatty acids, 3-hidroxybutyrate, insulin-like growth factor-I, growth hormone, estradiol and progesterone. Concentrations of glucose and insulin were also evaluated every 3 h during a 24 h after treatment. A liver biopsy was collected at 7 and 14 DIM and assayed for mRNA for bovine GH receptor and chemical composition. Yields of milk and components were measured for the first 90 DIM, and body condition (BCS) was scored at 1 and 60 DIM. Data were analyzed using the MIXED and Chi-square procedures of SAS (2001). In the first 24 h after treatment, concentrations of glucose in plasma were similar ($P=0.15$) and averaged 57.2 ±1.8 and 53.4 ±1.7 mg/dL for CON and INS cows. Rectal temperature was similar ($P=0.64$) for CON and INS during the first 10 DIM and averaged 39.3 oC. For CON and INS, respectively, yields (kg/d) of milk (40.7 vs 39.1), 3.5% fat-corrected milk (41.8 vs 41.5), energy corrected milk (37.8 vs 37.3), milk fat (1.50 vs 1.52) and true protein (1.17 vs 1.12) were similar ($P>0.10$). Similarly, mean and median BCS did not differ ($P>0.10$) for CON (2.75 and 2.84) and INS (2.63 and 2.71). All cows ovulated and DIM at first ovulation was similar ($P=0.80$) and averaged 20.5 d. Double ovulation was similar ($P=0.82$) between treatments and averaged 39.3%. Length of the first luteal phase did not differ between treatments and averaged 23.4 d. Treatment with insulin did not affect lactation performance or reproductive parameters evaluated.

Key Words: Dairy Cow, Follicle, Insulin

W219 Influence of parity on follicular dynamics and resumption of ovarian cycle in postpartum dairy cows. T. Tanaka*, M. Arai, S. Ohtani, S. Uemura, S. Kim, T. Kuroiwa, and H. Kamomae, *Tokyo University of Agriculture and Technology*, *Fuchu, Tokyo, Japan*.

The aim of the present study was to determine ovarian changes preceding the resumption of the ovarian cycle and their association with body energy status in postpartum dairy cows with different parities. In postpartum primi- (n=6), bi- (n=4) and multiparous (n=6) Holstein dairy cows, ovarian ultrasonographic observation starting at seven days after calving was performed every other day as a rule but daily after the confirmation of clinical signs of estrus for the detection of postpartum first ovulation. Blood samples were collected at ultrasonography and analyzed for estradiol and progesterone to monitor ovarian activity. To evaluate the nutritional condition of cows, body weight and body condition score (BCS, 1 = emaciated and 5 = obese) were measured weekly and blood samples for the analysis of glucose, insulin and non-esterified fatty acid (NEFA) were collected at the same time until postpartum second ovulation. The days to first ovulation after calving and the number of follicular waves preceding the first ovulation in primiparous cows were significantly greater than those in multiparous cows (31.8 ± 8.3 vs. 17.3 ± 6.3 days and 2.7 ± 0.8 vs. 1.3 ± 0.8 waves, $p<0.05$), but were not significantly different from biparous cows (28.8 ± 8.6 days and 2.0 ± 0.7 waves). Estradiol concentration on the day prior to the first ovulation in primiparous cows was significantly lower than that in multiparous cows (4.8 ± 2.3 vs. 9.6 ± 4.4 pg/ml, $p<0.05$). BCS was maintained at a

level of more than 2.5 during the postpartum period in all cows and the influence of parity on postpartum changes in BCS, glucose, insulin and NEFA was not found throughout the experiment. The present study demonstrated that the interval from calving to first ovulation in primiparous cows was longer than that in multiparous cows in association with the number of follicular waves under such similar body nutritional conditions.

Key Words: Parity, Postpartum First Ovulation, Dairy Cows

W220 Pregnancy loss in lactating Holstein cows diagnosed with twin versus singleton fetuses. N. Silva del Río*[1], J. D. Colloton[2], and P. M Fricke[1], [1]*University of Wisconsin*, *Madison*, [2]*Bovine Services LLC*, *Edgar, WI*.

Our objective was to characterize pregnancy loss (PL) for cows diagnosed with twin (T) vs. singleton (S) fetuses on a commercial dairy farm comprising 1,100 lactating Holstein cows. Records were collected by the herd veterinarian who performed weekly reproductive examinations using transrectal ultrasonography from January 2005 to February 2006. The initial data set included 2,048 pregnancy examinations (1,389 initial examinations and 659 re-examinations). The 730 observations with no recorded re-evaluation included 673 cows diagnosed not pregnant, 22 cows with nonviable fetuses, 33 cows diagnosed pregnant with a singleton fetus, and 2 cows diagnosed pregnant with twin fetuses. The remaining cows were either culled from the herd or were re-inseminated. Only records from cows diagnosed pregnant with a viable fetus from 27 to 40 d postbreeding that included a pregnancy re-evaluation from 48 to 82 d postbreeding were used to assess PL. Cows (n=13) identified with twin fetuses at the pregnancy re-examination but identified with singleton fetuses at the initial pregnancy examination were excluded from the data set. A total of 468 S cows and 74 T cows were included in the final data set. Pregnancies of S cows with 1 CL comprised 60.9% right horn with a CL on the right ovary and 39.1% left horn with a CL on the left ovary. Pregnancies of T cows with 2 CL comprised 26.1% unilateral right horn with 2 CL on the right ovary, 31.9% unilateral left horn with 2 CL on the left ovary, and 42.0% bilateral horn with one CL on each ovary. Overall, PL was greater ($P<0.01$) for T (25%) vs. S (4.9%) cows. For S cows with 1 CL, PL was 5.5 % (22/379), whereas PL for S cows with 2 CL was 1.5% (1/66). Among T cows, only 5 had 1 CL, and 3 of these cows lost 1 fetus and 1 lost both fetuses. For T cows with 2 CL, 8.6% (6/69) lost 1 fetus and 13.0% (9/69) lost both fetuses. We conclude that PL is greater for T compared to S cows and that spontaneous loss of one fetus and maintenance of the other can and does occur for T cows.

Key Words: Twinning, Pregnancy Loss, Dairy Cow

W221 Effects of twin pregnancy and prepartum diet on early postpartum ovarian activity in Holstein dairy cows. N. Silva del Río*, R. R. Grummer, and P. M. Fricke, *University of Wisconsin*, *Madison*.

To evaluate the effect of pregnancy type [singleton (S) vs. twin (T)], and prepartum feeding management [transition diet (NEL=1.54 Mcal/kg) for 3 (3TR) vs. 8 wk (8TR) before expected calving date (ECD)], on postpartum (PP) ovarian activity and periparturient traits, multiparous (n=39) and primiparous (n=8) Holstein cows were used in a 2×2 factorial randomized complete block design. All cows were feed a late lactation diet (NEL=1.58 Mcal/kg) from 90 to 60 d before ECD and the same early lactation diet (NEL=1.71Mcal/kg) after calving. At dry-off, cows were feed a transition diet for 8 wk before ECD (8TR) or far-off diet (NEL=1.32 Mcal/kg) for 5 wk followed by transition diet 21d before ECD (3TR). Thrice weekly (MWF), ovaries were evaluated with transrectal ultrasound, and blood samples were collected for serum progesterone (P4). Gestation length was shorter ($P<0.05$) for T than for S cows (276 vs. 281 d). Calf BW was greater ($P<0.05$) for twin vs. singleton calves (70.7 vs. 42.4 kg) and, for 5 of the twin pairs, the smaller calf was 24 % lighter than its cotwin. Numerically more retain placenta were recorded for T than for S cows (55 vs. 29 %), and more ($P<0.05$) T cows required calving assistance than S cows (70 vs. 30 %). Although prepartum serum P4 (-7 to 1 d relative to calving) was greater ($P<0.05$) for T than for S cows (2.5 vs. 1.9 ng/mL), no effect of treatment was detected for average d to first PP ovulation (40 ± 5 d); average d to first PP 10 mm follicle (15.0 ± 1.8 d); and diameter of the largest follicle at first PP ultrasound (7.0 ± 0.6 mm). No treatment effects were detected for the incidence of anovulation (9.1%) or short luteal phases (11.4 %). No treatments effects were detected on ovulation rate of the first PP dominant follicle (57.5%) or double ovulation rate at first (29.7%) or second PP ovulation (16.1 %). Thus, although T cows have a greater risk for negative periparturient traits than S cows, no effect of treatment was detected for PP ovarian activity.

Key Words: Twinning, Transition Diet, Early Postpartum Ovarian Activity

W222 Relationship between the occurrence of first ovulation in early postpartum and metabolic status in the cows that experiencing postpartum disease. M. Matsui*, E. Kaneko, M. Kataoka, C. Kawashima, N. Sudo, N. Matsunaga, M. Ishi, K. Kida, Y.-I. Miyake, and A. Miyamoto, *Obihiro University of Agriculture and Veterinary Medicine*, *Obihiro, Hokkaido, Japan*.

Our recent study showed that the cow with early first ovulation (1st OV) by 3 weeks postpartum (wk pp) has higher subsequent fertility, and that the metabolic status closely relates to the occurrence of early 1st OV. It is generally accepted that the cow with postpartum disease has delayed resumption of ovarian cycle and low fertility. In present study, the relationship between the occurrence of early 1st OV and metabolic status in cows experiencing postpartum disease was examined. We analyzed Holstein cows that had clinical record for postpartum paraplegia, retained placenta, abomasal displacement, mastitis and/or ketosis by 100 days pp. Weekly blood samples were obtained from 81 multiparous and 23 primiparous cows from 1st to 9th wk pp, and measured metabolites (glucose, non-esterified fatty acid: NEFA, aspartate aminotransferase: AST, γ-glutamyl transpeptidase: γ-GTP), metabolic hormones (growth hormone: GH, IGF-I, insulin) and progesterone (P4) concentrations. Increase in plasma P4 (≥ 1 ng/ml) by 3 wk pp was observed in 37 multiparous (45.7%) and 10 primiparous cows (43.5%), where those cows were confirmed as having early 1st OV. All data were evaluated by repeated measure analysis of variance. The average and values at each week by 3 wk pp were analyzed by Student's t-test. Multiparous cows with early 1st OV showed higher glucose at 3rd wk pp, lower AST at 2nd and 3rd wk pp, lower average of γ-GTP during 3 wk pp, lower GH at 3rd wk pp and higher average of insulin during 3 wk pp compared to the cows

having no ovulation. Lower NEFA at 1st wk pp, lower average of NEFA during 3 wk pp, and higher insulin at 3rd wk pp were observed in primiparous cows with early 1st OV. Data suggest that metabolic status in early pp influences the occurrence of early 1st OV in cows that experience postpartum disease. Hepatic function in multiparous cows and body fat mobilization in primiparous cows appear to relate to early 1st OV in pp. In addition, it may be common to these multiparous and primiparous diseased cows that insulin levels by 3 wk pp closely associate with early 1st OV.

Key Words: Dairy Cow, First Ovulation, Postpartum Disease

W223 Effects of dietary fats differing in proportion of unsaturated fatty acids on characteristics of preovulatory follicles in dairy cows. M. Katz*[1,2], A. Arieli[2], and U. Moallem[1], [1]*Agriculture Research Organization*, *Bet Dagan, Israel*, [2]*Faculty of Agriculture, Hebrew University*, *Rehovot, Israel*.

The objectives of this study were to examine the effects of dietary prilled fat containing low proportion of unsaturated fatty acids (LUFA) or calcium soap of fatty acids (FA) containing high proportion of unsaturated FA (HUFA), on characteristics of preovulatory follicles. Israeli-Holstein dry cows, 256 d pregnant, were divided into three treatments that continued until 100 d in milk: 1) Control - (n=14) were fed a dry cow diet and postpartum were fed a lactating cow diet; 2) LUFA - (n=13) were supplemented with 230 g/d per cow of prilled fat; 3) HUFA - (n=14) were supplemented with 215 g/d per cow of calcium soap of FA. At 40 d in milk the estrus cycle was synchronized. Fourteen d after behavioral estrus, cows were injected with $PGF_{2\alpha}$ and 48 h later > 7 mm follicles were aspirated (aspiration ranged 55 - 70 d in milk). Androstenedione (A_4), estradiol (E_2), progesterone (P_4), insulin and nonesterified FA concentrations in follicles were determined. Follicles with E_2/P_4 ratio higher than 1 were analyzed (n=39). Follicular A_4 concentrations were 69% higher in HUFA and 65% lower in LUFA than in control (181.3, 37.4 and 107.3 ng/ml, respectively, $P < 0.04$). Follicular E_2 concentrations were 40% higher in HUFA and 53% lower in LUFA than in control (1695.6, 572.5 and 1214.7 ng/ml, respectively, $P < 0.02$). Total A_4 and E_2 in follicles were higher in HUFA than in control with no differences between LUFA and control. No differences were observed in P_4 concentrations and content among groups. The E_2/P_4 ratio was 47% higher in HUFA and 41% lower in LUFA than in control (21.5, 8.7 and 14.7, respectively, $P < 0.05$). Nonesterified FA and insulin concentrations in follicles were not different among groups. In conclusion, the positive effect of dietary unsaturated FA on preovulatory follicle hormones may be beneficial to the oocyte, could improve estrus intensity and therefore contribute to fertility in dairy cows.

Key Words: Unsaturated Fatty Acid, Preovulatory Follicle

W224 Effects of endothelin-1 infused chronically adjacent the luteal-containing ovary or intrauterine in ewes on luteal function. C. W. Weems*, Y. S. Weems, D. Johnson, T. Uchima, E. Lennon, A. Raney, K. Goto, G. Bowers, J. Saldana, and J. Pang, *University of Hawaii*, *Honolulu*.

Endothelin-1 (ET-1) has been reported to mediate PGF2α-induced luteolysis (Hinckley and Milvae, Biol. Reprod. 64:1619, 2001). mRNA for ET-1 converting enzyme-1, pre-pro ET-1 and ET receptors increased in cow corpora lutea (CL) from D-1-10 postestrus, were similar on D-10 and D-17, were not increased by PGF2α on D-10, but were increased by PGF2α on D-17 when luteolysis was underway (Choudhary et al., Domest. Anim. Endocrinol. 27:63, 2004). PGE (PGE1 and PGE2) is antiluteolytic and luteotropic (C. Weems, Y. Weems, R. D. Randel. The Vet. J. 171:206, 2006). ET-1 increased PGE secretion by cow CL in vitro when estrus was not synchronized or when synchronized with PGF2α and did not affect CL PGF2α or progesterone (P4) secretion. This does not support ET-1 being luteolytic (Y. Weems et al.; Prostaglandins and Other Lipid Mediators 74:45, 2003). The objective of this experiment was to determine whether ET-1 infused every 6 h from 2400 h on D-10 to 1800 h on D-18 of the ovine estrous cycle into tissue of the ovarian vascular pedicle (IP-2μg) adjacent the CL ovary or intrauterine (IU-4 μg) was luteolytlc in ewes. Treatments were: Vehicle-IP (n=4); Vehicle-IU (n=4); ET-1-IP (n=5); or ET-1-IU (n=5). CL weights at 1800 h on day 18 were analyzed by a 2×2 Factorial Design for ANOVA. Jugular venous plasma at 0, 18, 42, 66, 90, 114, 138, 162, and 186 h was analyzed for P4 by RIA. P4 profiles were analyzed by a Split Plot Design for ANOVA for repeated measures. CL weights differed ($P \leq 0.05$) among treatment groups. CL weights (mg) at 1800 h on D-18 were: VEH-IP-247±38; VEH-IU-195±31; ET-1-IP-626±74; and ET-1-IU-542±69. CL weights were heavier ($P \leq 0.05$) in ET-1 IP or IU-treated ewes than Vehicle-IP or IU treatment groups and did not differ ($P \geq 0.05$) between ET-1 IP or IU groups. Profiles of P4 in jugular venous blood of Vehicle IP or IU were lower ($P \leq 0.05$) than in ewes treated with ET-1 IP or IU, which did not differ ($P \geq 0.05$) between ET-1 IP or IU treatment groups. In summary, ET-1 prevented the decrease in CL weights and the decline in P4 compared to controls. It is concluded that ET-1 may not be luteolytic, but antiluteolytic in ewes.

Key Words: Corpus Luteum, Endothelin-1, Progesterone

W225 Effect of extender on retention of viability and motility in hair sheep and goat semen stored at 4°C. J. L. Mook* and S. Wildeus, *Virginia State University*, *Petersburg*.

Liquid storage of chilled semen may provide an opportunity to expand the use of AI in small ruminants when used in conjunction with overnight shipping. This study evaluated the ability of various extenders to maintain motility and viability in hair sheep and goat semen. Ejaculates were collected via artificial vagina during the breeding season. For trial 1, two separate collections were used to generate pooled samples of 4 animals/species. Samples were extended in 2.9% sodium citrate, DPBS, DPBS with BSA, and TRIS with egg yolk (EY). Extended samples were initially kept at 25°C for 3 hand were then stored at 4°C for 24 h. Motility was assessed using a CASA system, and viability with eosin and Sybr14/PI staining at 0, 3, and 24 h. For trial 2, ejaculates from 6 animals/species were extended individually in TRIS, TRIS with BSA, TRIS with EY, non-fat milk, and a commercial 2-step extender (Continental Plastic Corp.). Extended samples were kept at 25°C for 6 h, and were then stored at 4°C until 48 h. Motility and viability were determined at 0, 3, 6, 24, and 48 h, and at 0, 12 and 48 h, respectively. For trial 1, total (Tmot) and progressive motility (Pmot) were influenced by an interaction of extender and storage time ($P<0.001$). Initial buck Tmot and Pmot, and ram Pmot were similar across all extenders. Ram samples in EY-containing extenders maintained higher motility and viability for the duration of storage ($P<0.05$). Buck samples demonstrated no change in viability

over time. In trial 2, initial Tmot and Pmot were higher ($P<0.05$) in TRIS with either EY or BSA over time. Ram samples extended in TRIS with EY had reduced ($P<0.05$) Tmot and Pmot initially compared to the other extenders, but maintained the highest motility over 48 h. No changes in viability were detected via eosin staining after 48 h, but Sybr14/PI staining indicated viability in rams was only maintained ($P<0.05$) in EY and milk. In both trials, effects on motility were usually notable within the first 3 h. These results show EY-based extenders maintained motility and viablity best, and should be evaluated further for long-term chilled storage of buck and ram semen.

Key Words: Semen, Hair Sheep, Goats

W226 Use of fecal progestin determinations to characterize the estrous cycle in captive female bontebok (*Damaliscus pygargus pygargus*). M. McGee*[1], A. Kouba[2], S. Bowers[1], R. Meek[2], B. L. Elliot[2], C. Horton[2], T. Hill[2], E. Piorkowski[2], and S. Willard[1], [1]*Mississippi State University*, *Mississippi State*, [2]*Memphis Zoo*, *Memphis, TN*.

The bontebok is an antelope that almost became extinct and is classified as "vulnerable". Information concerning their reproductive physiology is needed in support of propagation efforts. Our objective was to profile fecal progestins (PROG) of female bontebok to characterize the estrous cycle and reproductive season. Samples were collected from enclosures with positive identification of animal-fecal pairs. Fecal samples (n=1,132) were collected from n=6 female bontebok from July 2002 to Sept. 2005. Samples were stored at -20°C until extraction using 0.5 g of feces in 5 mL 80% Methanol with shaking for 12-14 h. Samples were centrifuged for 15 min and the supernatant analyzed for immunoractive fecal PROG in a progesterone RIA. Coefficients of variation (CV%) are reported as a statistical measure of variability among estrous cycles. Length of the estrous cycle was 20.7±1.4 d (range: 12-26 d; CV: 19.8%). For females that did not become pregnant, the number of estrous cycles exhibited in a season was 4.5±0.5 cycles (CV: 15.7%). Shifts in the seasonality of cycles were observed among individuals from year-to-year, attributed to environment (season) and/or previous reproductive status. As a representative example, a bontebok female (#L13871) gave birth in July 2002 and began cycling 137 d later from Dec. 4, 2002 to April 3, 2003 exhibiting n=5 estrous cycles (length: 22.4±1.5 d; CV: 14.6%) and did not become pregnant, shifting into anestrus. The next year #L13871 exhibited n=4 estrous cycles (length: 18.5±2.2 d; CV: 23.6%) that began and ended earlier than the previous year: Sept. 9, 2003 to Jan. 11, 2004. It is unclear whether lactational-induced anestrus resulted in a later reproductive season in 2002/2003 than 2003/2004, or whether a seasonal cue may have initiated the shift in cycles. In conclusion, this study has identified characteristics of the estrous cycle and reproductive season (possibly affected by previous reproductive status and/or environment) in captive bontebok. These data may assist in the reproductive management of this species to improve propagation efforts.

Key Words: Bontebok, Fecal Hormones, Estrous Cycle

W227 Cloning and characterization of chicken prostaglandin E receptor subtypes 2 and 4 (EP2 and EP4). A. H. Y. Kwok*, C. Y. Wang, Y. Wang, and F. C. Leung, *The University of Hong Kong*, *Hong Kong, HK-SAR, China*.

Prostaglandin E2 (PGE2) belongs to the eicosanoids and is an important chemical mediator regulating many vital physiological processes, including muscle relaxation, vascular homeostasis, gastrointestinal function and maintenance of pregnancy. Prostaglandin E receptor subtypes 2 and 4 (EP2 and EP4) are crucial mediators between its ligand, PGE2, and downstream intracellular cyclic AMP/protein kinase A (cAMP/PKA) signaling pathway. Both receptors were identified in mammals and zebrafish, but they have not been cloned in the avian species. In the present study, using reverse transcription-polymerase chain reaction (RT-PCR), the full-length cDNAs for chicken EP2 and EP4 receptors were cloned from adult chicken ovary and testis respectively. The full-length cDNA of EP2 gene encodes a precursor of 475 amino acids with a high degree of amino acid identity to that of mammals, including human (87%), mouse (86%), rat (84%), dog (85%), and cow (83%), and a low sequence identity to zebrafish (52%). Chicken EP4 is 356 amino acids in length and also shows high amino acid identity to that of mammals (human, 61%; mouse, 63%; rat, 61%; dog, 58%; cow, 59%) and a lower sequence identity to lower vertebrate (zebrafish, 41%). Using the pGL3-CRE-luciferase reporter system, we also demonstrated that PGE2 strongly induces luciferase activity of CHO/DF-1 cells expressing EP2 in a dose-dependent manner (EC50: <1 nM), confirming the functionality of the cloned EP2 receptor. The same experiment is also under way for EP4. The cloning and characterization of EP2 and EP4 receptors would help us to establish a molecular basis to elucidate the physiological roles of prostaglandin E2 in target tissues including their actions in chicken ovary.

Key Words: Chicken, PGE2, Prostaglandin E Receptors

W228 Pulmonary hemodynamic responses to intravenous prostaglandin E_2 in broiler chickens. S. Stebel and R. F. Wideman, Jr.*, *University of Arkansas*, *Fayetteville*.

Prostaglandin E_2 (PGE_2) affects pulmonary arterial pressure (PAP), pulmonary vascular resistance (PVR), and respiratory rate (RR) in mammals but no information previously was available regarding avian pulmonary responses to PGE_2. Two experiments were conducted in which 45 to 55 d old male broiler chickens were infused i.v. with PGE_2 at the lowest rate (30 µg/min for 4 min) that reliably reduced PAP by approximately 2 mm Hg during pilot studies. When compared with pre-infusion (Control) values in Experiment 1, PGE_2 reduced PAP from 19 ± 1 to 16 ± 1 mm Hg ($P<0.05$) and reduced mean systemic arterial pressure (MAP) from 111 ± 6 to 81 ± 5 mm Hg ($P<0.05$) but did not significantly reduce heart rate (HR) (Control: 338 ± 9 beats/min; PGE_2: 320 ± 12 beats/min; $P>0.05$). Infusing PGE_2 also reduced the respiratory rate (RR) from 57 ± 2 to 46 ± 4 breaths/min ($P<0.05$), and reduced the percentage saturation of hemoglobin with oxygen ($\%HbO_2$) from 85 ± 2 to 77 ± 3 % ($P<0.05$). The PAP, MAP, RR and $\%HbO_2$ all recovered to control levels after the PGE_2 infusion ceased. In Experiment 2 an ultrasonic flow probe was surgically implanted to measure cardiac output (CO). When compared with pre-infusion control values, PGE_2 reduced PAP from 25 ± 2 to 21 ± 1 mm Hg ($P<0.05$), reduced CO from 140 ± 6 to 111 ± 5 mL/kg BW × min ($P<0.05$), and reduced RR from 49 ± 4 to 35 ± 4 breaths/min ($P<0.05$). All of these variables recovered to control levels within 9 min after stopping the PGE_2 infusion. The reduction in CO was caused by a reduction in HR rather than stroke volume. The PVR, calculated as PAP/CO, was not altered by PGE_2 (Control: 0.180 ± 0.012 relative resistance units; PGE_2: 0.200 ± 0.017 relative resistance units; $P>0.05$). These results indicate that in broilers PGE_2 reduced PAP by reducing

CO rather than by acting as a pulmonary vasodilator to lower PVR. Reductions in CO, RR and blood oxygenation triggered by i.v. PGE_2 infusion previously have been reported for mammalian species in which specific PGE_2 receptors reside on parasympathetic neurons, suggesting parasympathetic inhibition of cardiac and respiratory function may play a role in the responses of broilers to PGE_2.

Key Words: Respiration, Hemodynamics, Cardiac Output

W229 Coordinate accumulation of the egg envelope glycoproteins during follicular development in Japanese quail (*Coturnix japonica*). T. Sasanami*[1], M. Ohtsuki[1,2], G. Hiyama[3], N. Kansaku[3], A. Tsukada[4], K. Tahara[4], T. Watanabe[4], T. Yoshimura[4], and M. Mori[1], [1]*Shizuoka University*, *Shizuoka, Japan*, [2]*Gifu University*, *Gifu, Japan*, [3]*Azabu University*, *Sagamihara, Japan*, [4]*Nagoya University*, *Nagoya, Japan*.

The extracellular matrix surrounding avian oocytes, termed as perivitelline membrane (PL), exhibit a three-dimensional network of coarse fiber between the granulosa cells and the oocyte. Our previous studies of Japanese quail have demonstrated that one of its components, ZPC, is synthesized in the ovarian granulosa cells. Another component, ZP1, which critically involves in triggering the sperm acrosome reaction in quail, is synthesized in the liver, and is transported to the surface of the oocyte in the follicles. We have previously isolated cDNAs encoding quail ZPC and ZP1, and now report the isolation of cDNA encoding quail ZPA. By RNase protection assay and *in situ* hybridazation with radio-labelled antisense probes to ZP mRNAs, we have demonstrated that ZPA transcripts are detected in the granulosa layer of small white follicles (SWF). Expression level of ZPA decreased progressively during follicular development (n=3, $P < 0.01$), and the highest expression was observed in SWF. On the other hand, ZPC transcripts increased as corresponding to follicular development (n=3, $P < 0.01$), but barely visible in SWF. Immunohistochemical analyses using specific antisera raised against ZP glycoproteins indicate that the immunoreactive materials recognized with anti-ZPA antiserum were detected in the apical side of the granulosa layers of SWF, and were also detected in the PL of small yellow follicles (SYF). However, the signal was not detected on the sections of SWF, which had been reacted with anti-ZPC as well as with anti-ZP1 antiserum. The intense staining with anti-ZPC antiserum was seen in the PL of SYF, whereas the weak signal was appeared when the section of 4th largest follicles was stained with anti-ZP1 antiserum. These results indicate that three PL glycoproteins are accumulated in a coordinate manner during the follicular development in quail, and the phenomena might contribute to the formation of the insoluble fiber of avian PL.

Key Words: Egg Envelope, Zona Pellucida, Japanese Quail

W230 Nicarbazin reduces egg production and fertility in White Pekin ducks via reducing ZP3 in the perivitelline membrane. V. P. Reinoso*, R. Katani, and G. F. Barbato, *The Pennsylvania State University*, *University Park*.

This study determined the dose-response relationship for the effect of nicarbazin in reducing egg production and/or hatchability in White Pekin ducks. Six dosages of nicarbazin were fed to female ducks with the range of doses being 0 ppm, 31.25 ppm, 62.5 ppm, 125 ppm, 250 ppm and 500 ppm for 14 days (n=12/dose group; N=72). Ducks were individually caged and artificially inseminated weekly with semen from untreated drakes. Control ducks had an average rate of lay of 93% with a mean fertility of 87%. Ducks receiving either 250 or 500 ppm nicarbazin had significantly reduced egg production within 2 days of treatment ($P<0.05$). The remaining groups had significantly reduced egg production by within 8 days of treatment ($P<0.05$). By the end of the treatment, all nicarbazin groups had significantly lower egg production than the control groups ($P<0.01$). Recovery of egg production after withdrawal of the nicarbazin treated diets occurred in reverse order of treatment dose, beginning 2 days after drug withdrawal, and completely recovering within 4 days. All nicarbazin groups had significantly lower fertility than the control group within 3 days ($P<0.05$). By seven days of nicarbazin treatment, the 500 ppm group had no fertile eggs (laying at 20%). The 125 and 250 ppm treatments eliminated fertility by day 27 (or 12 days post-treatment; $P<0.01$). Recovery of fertility followed the inverse of nicarbazin dose in the diet, preceding recovery of egg production by 2-3 days. Western blot analysis suggested a reduction in the presence of immunoreactive ZP3 (zona pellucida protein 3) in the perivitelline membrane of eggs laid by nicarbazin treated ducks. Furthermore, there were far fewer (<5%) sperm trapped in the perivitelline membrane of eggs from nicarbazin-treated ducks than in those from controls ($P<0.01$). The decreased fertility, western blots and dearth of trapped sperm in eggs of nicarbazin treated ducks implies a direct and negative effect of nicarbazin on ZP3, the putative sperm receptor, in the avian oocyte.

Key Words: Nicarbazin, ZP3, Ducks

W231 Isolation and culture of chicken oocytes. W. D. Berry*, S. S. Oates, L. M. Stevenson, and C. R. James, *Auburn University Poultry Science*, *Auburn, AL*.

A method of isolation and culture of chicken oocytes was needed to advance studies of oocyte development. The isolation of immature chicken oocytes was accomplished by enzymatic digestion of the chick ovary to disperse the immature oocytes. Ovaries were harvested from newly hatched chicks. The ovaries were collected into 4C calcium/magnesium free Hanks balanced salt solution (HBSS). The ovaries were washed 3 times in HBSS containing antibiotics/antimycotics, then finely minced in the HBSS. The minced tissue was then incubated with agitation for 60 minutes at 37C in a sterile enzymatic dispersal solution containing hyaluronidase, type 2 collagenase, and pronase. The dispersal solution containing the digested tissue was then filtered through a 100 micron filter and centrifuged at 25×g, at 4C, for 7 minutes. The cell pellet was then resuspended in minimal essential medium (MEM) and repelleted by centrifugation, followed by another resuspension step. The cell suspension was then cultured for 6 hours in MEM to remove contaminating fibroblasts by attachment. Alternatively, contaminating fibroblasts were removed by centrifuging the cell suspension through a Percoll gradient. Following fibroblast removal, the isolated oocytes were pelleted by centrifugation, resuspended in MEM and counted on a hemocytometer. Each chick ovary yielded 12,000 to 25,000 viable oocytes. The isolated and purified oocytes were cultured for up to one week in supplemented Dulbecco's MEM-Hams F-12 medium. Oocytes were also preserved at -20C in 95% ethanol. This work was supported by the Alabama Agricultural Experiment Station and the U.S. Poultry and Egg Association.

Key Words: Oocyte, Isolation, Chicken

W232 Gene expression of hen granulosa cell (GC) steroidogenic enzymes and gonadotropin receptors following a chronic heat stress (HS) episode. H. Taira*[1] and M. M. Beck[2], [1]*University of Nebraska*, *Lincoln*, [2]*Clemson University*, *Clemson, SC*.

This study was conducted to determine the effect of HS on gene expression of several key enzymes and hormone receptors in the steroidogenic pathway in GC of laying hens and to determine whether the hen responds like the rat. HS reduces synthesis of and circulating luteinizing hormone (LH), progesterone (P_4) and estrogen in hens, interfering with reproduction. In earlier studies, GC from hens subjected to HS synthesized less P_4 , even when stimulated by LH and 3β-hydroxysteroid dehydrogenase (3β-HSD) activity was reduced, while incubation with LH+FSH increased the activity. In this study, three strains of Hy-Line® laying hens (W36, W98 and CV20) were subjected to 35C (HS) for two wk or maintained in a thermoneutral (TN, 22C) environment. GC from the largest follicles were isolated and enzymatically dispersed. Aliquots of 100,000 viable cells were incubated with or without LH+FSH and the expression of mRNAs of steroidogenic acute regulatory protein (StAR), cytochrome P450 side-chain cleavage (P450scc), LH and FSH receptor (LH-R, FSH-R) and 3β-HSD were analyzed using real time RT-PCR normalized to 18s. Compared to TN, HS did not affect the expression of mRNA of P450scc, LH-R or FSH-R in any strain (P>0.1). Expression of StAR mRNA was reduced by HS in GC in W36 (P=0.0033) but not W98 or CV20 (P=0.6422, P=0.5275, respectively). Reduced 3β-HSD mRNA expression was observed only in CV20 (P=0.0589) and hormone incubation did not improve gene expression in any strain. This is somewhat inconsistent with earlier studies, in which HS reduced GC 3Î²-HSD activity and increased the number of apoptotic GC. The lack of a correlation between expression of 3β-HSD mRNA and enzyme expression under HS may suggest that HS interferes at translational but not the transcriptional level, that other factor(s) (e.g., increased PRL) maintain enzyme stability or receptor regulation, or that the effect of incubation times of hormones on different genes varies. A similar lack of correlation between mRNA and enzyme activity may be true for StAR and P450scc. Different methodologies made direct rat comparisons difficult.

Key Words: Steroidogenesis, mRNA

W233 Some observations on molting male Japanese quail. B. K. Biswas and K. L. Arora*, *Fort Valley State University*, *Fort Valley, GA*.

Molting is one of the important factors that cause significant changes in physiological and morphological characteristics in Japanese quail (*Coturnix japonica*). Our observations on **molting males** made during October 2006 and February 2007 are reported here. Each male (n=20; age 130-50 d) was housed in a separate cage (LD=16:8) with females. The birds were weighed regularly and blood was collected from the wing vein for determining PCV, glucose, and total plasma proteins. The cloacal gland was also measured. Some birds were euthanized to observe the size of testes. The birds started loosing feathers around the neck, then chest and back. The birds ceased crowing and lost some weight during molting. The testes were significantly reduced in size (4-5 vs 14+ mm) and weight (40-50 mg vs ~1.8 g). The cloacal gland was also significantly reduced from 14-19 mm to 6-8 mm. At the same time, the fertility in terms of fertile eggs laid by the cage-mate females was reduced to zero with the reduction of cloacal gland size. After molting the birds regained feathers starting around the neck, followed by chest and then extended backward toward the tail. The cloacal gland as well as testes also regained its normal size and weight. Fertility in male returned to 100% which have regained the size of cloacal gland to a minimum of 14 mm. The PCV of some male birds decreases (53.2% vs. 48.1%; p>0.05) and total plasma proteins increases (3.6 vs 4.2 mg/dl; p>0.05) during molting. Our observations indicate that the size of cloacal gland, testes and fertility in males are interrelated, and the cloacal gland size can serve as an indicator for male capability to fertilize eggs.

Key Words: Japanese Quail, Molting, Cloacal Gland

W234 Rooster semen cryopreservation: Effect of line and male age on sperm function. D. C. Bongalhardo*[1], J. Pelaez[1], J. E. Fulton[2], S. Saxena[2], P. Settar[2], N. P. O'Sullivan[2], J. Arango[2], and J. A. Long[1], [1]*Beltsville Agricultural Research Center*, *Beltsville, MD*, [2]*Hy-Line International*, *Dallas Center, IA*.

The fertility rates of cryopreserved poultry semen are highly variable and not reliable for use in commercial production or preservation of genetic stocks. Our objective was to evaluate the cryosurvival of semen from 8 pedigreed layer lines at the onset and end of production. Semen from 160 roosters (20/line) was frozen individually with 11% glycerol at 6 and 12 mths of age. Glycerol was removed from thawed semen by Accudenz gradient centrifugation. The viability of thawed sperm from each male was determined using SYBR/PI and flow cytometry. The fertilizing ability of thawed sperm was evaluated in vitro by assessing hydrolysis of the inner perivitelline layer. Hydrolysis data were grouped in 3 categories: <20 holes/mm^2; 21-80 holes/mm^2; and >81 holes holes/mm^2. Viability data were compared among lines and between age groups by repeated measures ANOVA. For hydrolysis data, logistic regressions were calculated to predict the natural log of the odds for males within lines to be in 1 of the 3 categories. The percentage of live sperm increased (p<0.0001) with age (6 mths, 35.6±0.8; 12 mths, 41.4±0.7%) and differed (p<0.0001) among lines, with 1 line consistently superior at both 6 and 12 mths. Hydrolyzing ability increased (p=0.0003) from 6 (54.5±6.1 holes/mm^2) to 12 mths (96.7±9.4 holes/mm^2) and differed among lines, with the odds of sperm hole category dependent upon line and age. Overall, viability was correlated with sperm hole number (r=0.24, p<0.0001) and category (r=0.25, p=0.0004); however, when the hydrolysis data were split by line and/or age, only 1 line consistently was correlated at both ages. These results demonstrate variability among pedigreed lines in withstanding glycerol-based semen cryopreservation. Further delineation of genotypic and phenotypic factors impacting sperm cryosurvival will be investigated in these genetic stocks.

Key Words: Chicken, Freezing, Fertilizing Ability

W235 Transcript profiling in mammary of ovariectomized pregnant gilts receiving progesterone and relaxin replacement therapy in late gestation. D. E. Graugnard*, J. J. Loor, E. A. Cutler, R. E. Everts, S. L. Rodriguez-Zas, and W. L. Hurley, *University of Illinois*, *Urbana*.

Relaxin-family peptides appear to have been important for the evolution and adaptation of lineage-specific physiologic processes (e.g.

lactation) during evolution. We previously determined that relaxin has a stimulatory effect on growth of mammary parenchymal tissue during late gestation (d 80-110) in the pig (Endocrinol. 128:1285-1290). To explore mammary genomic adaptations elicited by relaxin we used a swine oligoarray (70 mer) with 13,263 functional hits for transcript profiling of mammary tissue (n = 5/group) from control gilts sacrificed on d 110 of gestation (C110), gilts ovariectomized on d 100 and receiving progesterone (OP110), and gilts as in OP110, but also receiving porcine relaxin (OPR110). Annotation of the array was based on similarity searches using BLASTN and TBLASTX against human, mouse, and pig UniGene databases, the human genome, and pig TIGR. Cy3- and Cy5-labelled cDNA from mammary tissue and a reference standard were used for hybridizations. ANOVA ($P \leq 0.05$) identified 337 differentially expressed genes with OP110 or OPR110 vs. C110. Among these, there were 111 downregulated genes (ANGPT2, TAF12, NR1D2) by ≥2-fold with OP110 or OPR110 vs. C110. The extent of downregulation vs. C110 was more pronounced with OP110 (2-to-24-fold) than OPR110 (2-to-4-fold). Relaxin replacement therapy partially corrected downregulation of genes elicited by ovariectomy as shown by differences in expression between OP110 and OPR110, e.g. 102 genes with 2-fold (E2F5, AP2M1, TP53BP1) to 13-fold (LALBA, CSN1S2A, ANGPT2) upregulation due to OPR110 vs. OP110. Ingenuity Pathway Analysis of ≥2-fold upregulated genes with C110 and OPR110 vs. OP110 showed that molecular transport (19 genes), cell signaling (15 genes), cell growth/proliferation, and carbohydrate/lipid metabolism (10 genes in each) were among the most significant families of related genes. Overall, results demonstrate previously unrecognized genomic adaptations in the mammary gland elicited by relaxin.

Key Words: Mammary Gland, Relaxin, Micro Array

W236 Effect of boron supplementation on semen quality in mature boars. W. L. Flowers*[1], J. W. Spears[1], and F. H. Nielsen[2], [1]*North Carolina State University*, *Raleigh*, [2]*USDA-ARS, Grand Forks Human Nutrition Center*, *Grand Forks, ND*.

The objective of the study was to determine the effect of dietary boron on sperm production and semen quality in mature boars. Twelve crossbred boars (Landrace × Large White × Duroc × Hampshire) that were 2.5 ± 0.2 years of age and 215 ± 5 kg were randomly assigned to receive 0, 25, or 250 mg per head per day of supplemental boron for 8 weeks (n=4 per treatment). Boron was added to their basal diets and boars were fed 2.75 kg daily of a corn-soybean meal diet (14% crude protein). Concentrations of boron in the whole semen and seminal plasma fractions of ejaculates collected at the end of 7 weeks were different among treatments ($P<0.05$). The highest and lowest levels in semen and seminal plasma were measured in boars receiving 250 (708.7 and 692.0 ng/ml) and 0 mg of supplemental boron (88.9 and 76.5 ng/mL), respectively, while concentrations in boars receiving 25 mg (148.0 and 145.4 ng/mL) were in between the other two treatments. No effect of time or treatment on semen volume ($P>0.70$); total number of spermatozoa per ejaculate ($P>0.82$); or the proportion of spermatozoa exhibiting progressive forward motility ($P>0.89$) was observed. There was a tendency for a time by treatment interaction ($P=0.09$) for the proportion of spermatozoa with normal morphology. Normal morphology averaged 72.0% for control boars and did not change over time ($P>0.89$). In contrast, it tended to increase ($P<0.10$) from 74.7% and 76.1% during the first week of the study to 86.4% and 88.2% during week 8 in boars fed 25 and 250 mg of boron, respectively. Average path, straight line, and curvilinear velocities of motile spermatozoa increased over time ($P<0.05$) in boars receiving supplemental boron, but remained constant ($P>0.45$) in control boars (treatment × time; $P<0.05$). In conclusion, supplemental dietary boron enhanced sperm velocity characteristics and possibly, normal morphology, without influencing other measures of sperm production and semen quality.

Key Words: Boars, Boron, Spermatogenesis

W237 Transient transgene transmission to piglets by sperm-mediated gene transfer. Z. Wu[1], Z. Li[1,2], and J. Yang*[2], [1]*South China Agricultural University*, *Guangzhou, Guangdong, China*, [2]*University of Hawaii*, *Honolulu*.

An efficient and low-cost production of transgenic pigs has significant applications to the pig industry and biomedical science. Generation of transgenic pig by sperm-mediated gene transfer was inexpensive and convenient, but reported with inconsistent results. To test the method of sperm-mediated gene transfer in pigs, we employed deep post-cervical intrauterine insemination of incubated spermatozoa in this study. A test of sperm motility of semen from nine Landrace boars after incubation with radioactively-labeled DNA construct indicated that DNA uptake of the sperm were highly correlated with sperm motility at the time of collection. DNA concentration of 50 and 300 μg per one billion sperm was incubated with washed sperm at 17°C for 2h. Twenty-one hybrid gilts and sows of Meishan crossed with Large White were inseminated with transgene-incubated sperm and produced 156 piglets. Transgene DNA sequences were identified in 31 piglets by PCR amplification of genomic DNA isolated from piglet ears at the age of 3 days. The deep intrauterine insemination had a higher rate of positive transgenic piglets than regular insemination (29.6% of 98 piglets vs 3.4% of 58 piglets). However, the exogenous transgene DNA was not detected in all the piglets at the age of 70 to 100 days. Therefore, the results further demonstrated that that transgene through incubation with sperm was mostly transiently transmitted to the offspring at early growing stage and lost in adulthood, which may result from episomal DNA replications during germ cell division.

Key Words: Transgenic, Sperm-Mediated Gene Transfer, Episome

W238 Computer-assisted analysis of sperm parameters after selection of motile sperm by either percoll gradient, filtration or swim-up procedures. C. N. Person*, T. D. Lester, M. D. Person, and R. W. Rorie, *University of Arkansas*, *Fayetteville*.

A Hamilton-Thorne IVOS sperm analyzer (CASA) was used to compare sperm parameters of frozen-thawed semen from 10 bulls, before and after selection of motile sperm by either percoll gradient, filtration or swim-up procedures. Semen was thawed, washed in TALP medium and initial sperm parameters measured before assignment across selection methods. Sperm parameters measured at 0, 4 and 8 h after selection included motility, progressive motility, velocity distribution, path velocity (VAP), progressive velocity (VSL), track speed (VCL), lateral amplitude (ALH), beat frequency (BCF), straightness (STR), linearity (LIN), elongation and area. Percoll separation resulted in more total motile sperm recovered than either swim-up or filtration ($P=0.00$), while swim-up did not differ from

filtration (P=0.31). Percent motile, progressive, and rapid sperm did not differ (P=0.87, 0.91, and 0.94, respectively) across treatments. Across bulls, the percent motile sperm declined by ~50% from 0 to 4 h of culture, and by another ~33% from 4 to 8 h of culture. The VAP and VSL were similar (P≥0.09) across treatments, whereas VCL was greater (P=0.00) for both filtration and swim-up than for percoll. Sperm LIN and STR were similar across treatments (P=0.24 and 0.89). The ALH was greater for filtration and swim-up than for percoll (P≤0.01). The BCF for filter selected sperm was greater than that of either percoll or swim-up (P≤0.00). Sperm head elongation and area were also greater for filter selected than either swim-up or percoll (P≤0.00), whereas these parameters were similar for percoll and swim-up (P≥0.68). Based on total motile sperm recovered, percoll separation is superior to the other methods. Overall, results suggest that the method used for selection of motile sperm can influence some of the parameters related to motility and sperm head morphology. Further study is needed to determine if these differences are related to fertilization rate or developmental competence after IVF.

Key Words: Bovine, Sperm Parameters, CASA

Production, Management & the Environment - Livestock and Poultry III

W239 Effect of soaking dairy cows at the feed line on animal body temperature in a tunnel ventilated barn equipped with evaporative pads located in a tropical climate, Thailand. D. V. Armstrong*[1], M. J. VanBaale[1], S. Rungruang[2], V. Wuthironarith[2], M. J. Brouk[3], and J. F. Smith[3], [1]*The University of Arizona*, *Tucson*, [2]*Charoen Pokphand Group Co., Ltd.*, *Bangkok, Thailand*, [3]*Kansas State University*, *Manhattan*.

An experiment was conducted on ten lactating Holstein cows to evaluate the effect of soaking dairy cows at the feed line. The cows were housed in a two row tunnel ventilated free stall barn equipped with evaporative pads and a feed line soaker system. The free stall barn is 16 m by 113 m with a ceiling height of 2.6 m. The barn is equipped with 55.7 sq m of 2.4 cm thick evaporative pads on one end and eleven 130 cm fans on the opposite end of the barn. Air speed in the barn at animal shoulder height averages 9.7 km per hour. Air exchange is every 42 sec. Two treatments were utilized in this experiment: no feed line water spray (C) and feed line spray (FLS) from 1100 to 0600. Treatments were reversed every 4 days in a 2 × 2 Latin square design. The soaker cycle was 1 minute on and 4 minutes off. Water application was 2.8 liters of water per cow per cycle. Nozzles are located every 1.87 m on the line located at a height of 1.6 m from the floor. The average ambient temperature was 29.1°C, with relative humidity (RH) at 68%, and a temperature humidity index (THI) of 79. The average temperature inside the barn was 25°C, with the RH at 91% and a THI of 78. Individual cows were fitted with stainless steel temperature data loggers that recorded their core body temperature (CBT) at five-minute intervals throughout the study. Average CBT for the control group was higher, 39.08°C, than the cows with FLS, 38.99°C and is significant (P<0.01). The results of this trial suggest that feed line soaking has an additive effect for cooling cows in a tunnel ventilated barn located in a tropical climate. The difference between treatment CBT was from 06:00 to 09:00 when the ambient relative humidity is the highest and the difference between ambient and barn temperature is the lowest.

Key Words: Body Temperature, Feed Line Cooling, Tropical Climate

W240 Effect of soaking dairy cows at the feed line on animal behavior in a tunnel ventilated barn equipped with evaporative pads located in a tropical climate, Thailand. D. V. Armstrong*[1], M. J. VanBaale[1], S. Rungruang[2], V. Wuthironarith[2], M. J. Brouk[3], and J. F. Smith[3], [1]*The University of Arizona*, *Tucson*, [2]*Charoen Pokphand Group Co., Ltd.*, *Bangkok, Thailand*, [3]*Kansas State University*, *Manhattan*.

An experiment was conducted on ten lactating Holstein cows to evaluate the effect of soaking dairy cows at the feed line. The objective of the study was to observe if there are any changes in animal behavior for dairy animal that are soaked at the feed manger for 19 hours per day. The cows were housed in a two row tunnel ventilated free stall barn equipped with evaporative pads and a feed line soaker system. The free stall barn is 16 m by 113 m with a ceiling height of 2.6 m. The barn is equipped with 55.7 sq m of 2.4 cm thick evaporative pads on one end and eleven 130 cm fans on the opposite end of the barn. Total air exchange for the barn takes place every 42 sec. Treatments were no feed line water spray (C) and feed line spray (FLS) from 1100 to 0600 (19 hours). Treatments were reversed every four days in a 2 X 2 latin square design. The soaker cycle was 1 minute on and 4 minutes off. Water application was 2.8 liters of water per cow per cycle. Nozzles are located every 1.87 m on the line, which is at a height of 1.6 m from the floor of the feed line. Cow behavior data was collected every 15 minutes for 24 hours (96 observations per cow) over a 5 day period. Each pen of cows was on the C or FLS treatment for 5 days and then the groups were reversed. Twenty-four hour cow observation took place on day 5 of each period. The results would indicate three of the measurements of dairy animal behavior were changed with the addition of a feed line water soak for 19 hours per day. The time that cows spent eating was increased from 14.9% in the control group to 16.7% for the FLS. Standing time at the feed line was also increased to 6.2% for FLS compared with 4.4% for C. Time spent at the water trough was higher for C at 4.9% than 3.3% for FLS. All other observations were not measurably different.

Table 1.

Item	Control	% of time per day Feed line water soak	Remarks
Eating at manger	14.9	16.7	@
Standing at feed line	4.4	6.2	@
Lying at feed line	0.0	0.0	
Standing in free stall	17.8	16.1	
Lying in free stall	47.7	46.4	
At water trough	4.9	3.3	@
At milking area	10.9	11.3	

@ P<0.05

Key Words: Animal Behavior, Feed Line Cooling, Tropical Climate

W241 Thermal status for different breeds of dairy cattle exposed to summer heat stress in a grazing environment. J. N. Spain*[1], L. Parsons[1], R. Crawford[2], C. Brown[2], and D. E. Spiers[1], [1]*University of Missouri*, *Columbia*, [2]*Soutwest Research Center*, *Mt. Vernon, MO*.

There are few studies that have measured the long-term thermal status of different breeds of dairy cows maintained simultaneously in a pasture environment to determine differences in thermoregulatory responses to summer heat stress. A study was conducted to investigate thermal balance of lactating dairy cattle managed in an intensive managed rotational grazing system. The farm was located at the University of Missouri Southwest Research Center in Vernon County, MO. Thirty six lactating cows were blocked by parity, days in milk, milk production and breed. Cows were grouped by breed with 100% Holstein (H, n=8), 75%H:25% Jersey (J) (75H, n=5), 50%H:50%J (50H, n=8), 25%H:75%J (75J, n=7), and 100% J (J, n=8), and maintained on the same pastures from June 15 through August 1, 2006. Cows were rotated to paddocks to maintain ad libitum access to pasture. Ambient variables, including air temperature (Ta) and relative humidity, were measured continuously by a weather station at the Center. Ranges of Ta and calculated THI were 12 to 38C and 55 to 87, respectively. Thermal balance was evaluated prior to morning (0500) and afternoon (1600) milking by measuring rectal temperature (Tre), respiration rate (RR) and skin temperature on 16 days throughout the study during periods of maximum and minimum heat stress. Breed groups had different body weights ($p < 0.0001$) ranging from 530 kg (H) to 378 (J). However, body weight was similar for 75J and 75H (460 kg versus 501 kg, respectively). Although body weights were different across breed, change in rectal temperature with Ta ($r = 0.89$) and THI ($r = 0.92$) was predictable ($p < 0.0001$). Change in Tre with increasing Ta and THI was slowest for J and 75J, and highest for H and 75H. Change in Tre was influenced more by breed more than body weight. Respiration rate was highest for H and lowest for J at Ta below 30C. At Ta greater than 35C, J and 75J had RR similar to 50H. Cows with the highest percentage H (H and 75H) had lowest RR. These results suggest that breed selection can be used to improve thermal balance of cows managed in intensively managed rotational grazing systems.

Key Words: Heat Stress, Thermal Balance, Grazing

W242 Labor, housing, feeding, and bedding affects on herd turnover rate and mortality rates of Southeastern Pennsylvania dairy herds. C. D. Dechow[1] and R. C. Goodling*[2], [1]*The Pennsylania State University*, *University Park*, [2]*The Pennsylvania State University Cooperative Extension*, *University Park, PA*.

Various aspects of dairy operations were surveyed and compared to herd turnover rate and herd mortality rates. 269 Southeastern Pennsylvania dairy herds were surveyed to determine hours of full time and part time labor, type of facilities, bedding source, feeding system, and other herd management systems for each facility. Of these, 239 had viable 2005 DHI culling information to derive comparisons. Herd sizes ranged from 17 to 760 cows. Herds had at least nine test days, and at least ten cows per test day to be included in the analysis. Herd turnover rate groups were designated as low (≤0.20), low-to-moderate (0.21 to 0.30), moderate-to-high (0.31 to 0.40) and high (>0.40). Data were analyzed using the MEANS and GLM procedures of SAS version 9.1. Hours worked with lactating cows by part-time employees tended to be higher (P<0.03) in herds with higher turnover rates. Herds with higher turnover rates had more prevalent bST use (P<0.03). Lower turnover rate herds had greater access to pasture (P<0.007) and more ventilation (P<0.009). Lower mortality rate herds also tended to have greater access to pasture (P<0.07). Herds that fed lactating cows a TMR had moderately higher turnover rates than herds using component feeding (P<0.0001). No bedding types showed tendencies for higher or lower turnover and mortality rates. Further investigation into dry cow and heifer management, and potential confounding effects of herd size and production level with management type should be considered.

Key Words: Herd Turnover Rate, Mortality Rate, Management

W243 Body weight and condition score of four dairy genetic groups in summer or winter under low-input management. D. G. Johnson*[1], B. J. Heins[2], L. B. Hansen[2], A. J. Seykora[2], and J. G. Linn[2], [1]*University of Minnesota*, *Morris*, [2]*University of Minnesota*, *St. Paul*.

Holsteins selected for high production (H), Holsteins maintained at 1964 breed average level (C64), crossbreds including combinations Holstein, Jersey, and/or Montbeliarde selected for high production (HJM), and crossbreds including combinations of Holstein, Jersey, and/or Scandinavian Red selected for durability (HJS) were weighed and scored for body condition(1-5) on two consecutive months during summer and winter over three years. Groups studied were cows, bred heifers in second trimester, heifers being bred, and calves 8-10 months of ages. Animals within age group were fed and managed as a group. All groups were grazed during summer, only calves and lactating receiving cereal supplementation. Diets during winter were total mixed rations fed to requirements for growth and/or lactation and comprised of corn silage, alfalfa silage, grass hay, corn grain, soybean meal, distillers dried grains, and vitamin mineral supplements. Animals were housed on pasture or outdoor bedded packs during winter. All animals were located in west central Minnesota. Analysis by age group utilized SAS Mixed procedure with the model year, season, breed, year (breed), season (breed). Animal numbers were cows, 343; bred heifers, 298; breeding heifers, 269; and calf, 236; with 1 to 6 opportunities for an animal to appear in the data set. H and C64 cows were heavier then HJM or HJS, with cow weights higher in winter than in summer. Rank of condition scores was C64, 3.45, HJS, 3.15; HJM, 3.11; and H, 2.96.

Springer weights did not differ, but condition scores of H were lower than the other breeds. Breeding heifers and calves displayed a similar pattern. Winter weights tended to be higher than summer weights across all groups, but the pattern of condition scores was less consistent.

Key Words: Reduced Input, Dairy, Crossbred

W244 Phosphorus removal capacity of forages used on South Florida dairies. Y. C. Newman*, J. M. Scholberg, M. B. Adjei, and L. E. Sollenberger, *University of Florida*, *Gainesville*.

Excess accumulation of soil phosphorus (P) associated with intensively managed dairy operations has been linked to degradation of natural ecosystems. Warm-season perennial forages offer a complimentary and cost effective approach in remediation of soils with high P accumulation for livestock operations in the Lake Okeechobee region in South Florida. The objective of the study was to determine the P removal capacity, herbage production, and nutritive value of two warm-season species when managed for hay under intensive N fertilization. Bahiagrass (BG; Paspalum notatum) and limpograss (LG; Hemarthria altissima) were evaluated in an on-farm study during 2004 and 2005. Treatments were four levels of N fertilization rates (0, 50, 67, and 100 kg N ha^{-1} per harvest). Experimental units were 116-m^2 plots replicated four times in a randomized block design for each forage type. Data were analyzed using mixed model methodology through MIXED procedure of SAS and the nature of the N effects was assessed using orthogonal polynomial contrasts. Averaged across years, annual P removal of bahiagrass and limpograss had a linear ($P \leq 0.01$) increase with increasing N fertilization rate (26.2, 34.2, 40.5, and 39.4 kg P ha^{-1} yr^{-1} for bahiagrass, and 26.4, 40.0, 40.1, and 42.0 kg P ha^{-1} yr^{-1} for limpograss when fertilized with 0, 50, 67, and 101 kg N ha^{-1}, respectively). Herbage production and crude protein increased linearly ($P \leq 0.01$) with N fertilization treatment for both grasses in both years but crude protein values were consistently lower for LG compared to BG (average of 70 and 126 g kg^{-1}, respectively). Hay crop production using bahiagrass and limpograss is a feasible practice for removing excess soil P.

Key Words: Phosphorus, Bahiagrass, Limpograss

W245 Efficiency of use of imported magnesium, sulfur, copper, and zinc in Idaho dairy farms. A. N. Hristov*, W. Hazen, and J. W. Ellsworth, *University of Idaho*, *Moscow*.

Six commercial dairies from south central Idaho were surveyed to estimate the whole-farm surpluses of magnesium (Mg), sulfur (S), copper (Cu), and zinc (Zn). Mineral imports and exports were monitored in a 12-mo period and samples from the diets, feeds, feces, urine, and manure were collected at regular farm visits. Soils from manure-amended fields were sampled in the spring and fall. In all cases, the largest import of Mg, S, Cu, and Zn to the dairy was with purchased feeds, from 91 (S) to 97% (Zn) of all imports. The major mineral export item was manure (from 60%, S to 89%, Cu of all exports) and forages, in the case of a dairy with a large land base. Export with milk represented on average only 8.6, 25, 2.1, and 11% (Mg, S, Cu, and Zn, respectively) of all exports. Thus, the conversion of the imported feed Mg, S, Cu, and Zn into milk was rather low (on a whole-farm scale): 5.6, 11, 1.4, and 5.2%, respectively. Concentrations of Mg, Cu, and Zn in the lactating cow diets from the participating dairies exceeded current NRC recommendations on average by 85, 34, and 73%, respectively, which contributed to the inefficient use of imported minerals. Whole-farm Mg surplus varied from 4 to 54 t/yr (SD = 21.5; or 3 to 19 kg/cow per year). The efficiency of use of imported Mg varied from 27 to 88% (SD = 24.0). Sulfur surpluses were from 9 to 52 t/yr (SD = 18.0; or 12 to 40 kg/cow per yr). Copper and Zn surpluses were also significant (average of 59 and 585 kg/yr; SD = 59.9 and 711; or 0.05 and 0.4 kg/cow per year, respectively). The average efficiency of use of imported S, Cu and Mg was 44, 62, and 56% (SD = 12.3, 25.1, and 12.6), respectively and, as with Mg, varied significantly among the dairies. The results from this study suggest that reduction in the concentration of dietary Mg, Cu, and Zn is potentially the most efficient way of reducing overall excretions and whole-farm surpluses of these minerals.

Key Words: Dairy Farm, Nutrient Management

W246 Reproductive status of dairy herds in Alberta: An objective assessment based on milk progesterone (P4) concentrations. D. J. Ambrose*[1], M. G. Colazo[1], and J. P. Kastelic[2], [1]*Alberta Agriculture and Food*, *Edmonton, AB, Canada*, [2]*Agriculture and Agri-Food Canada*, *Lethbridge, AB, Canada*.

To identify the factors contributing to poor reproductive efficiency 23 dairy herds were evaluated. Milk samples from 637 cows (26±2 cows/herd) were collected 2x/wk, from 7 to 120 d postpartum (pp), and P4 determined; health and reproductive records were also obtained. The interval from calving to first rise in P4 pp was 32.0±0.7 d. The % of cows cycling by 3, 6, 9, and >9 wk pp was 27, 75, 90, and 96, respectively. Only 4.4% of cows remained anestrus by 90 d pp. The first estrous cycle was short (<17 d), normal (17 to 24 d), or long (>24 d) in 42, 45, and 13% of the cows, respectively. Mean d from calving to first service was 88.5±1.4 (range 32 to 267 d). By 80, 100 and 125 d pp, 42, 62 and 77% of the cows, respectively, were inseminated. Based on milk P4 at AI (n=266) 89% of the cows were in a stage conducive (P4<1 ng/mL) to conception. Conception rate (CR) to first service (38.4%) was influenced by parity (P<0.03), with higher CR in young cows (1st+2nd: 46) than in mature cows (3rd+4th: 39; >4th: 32%). Cows that had their first rise in P4 within 3 wk pp had higher CR to first service than cows that had a delayed rise (46 vs. 31%; P<0.03). The % of cows pregnant by 80, 100 and 125 d pp was 18, 31, and 43%, respectively. Cows with reproductive disorders during the pp period had lower CR by 125 d (P<0.01; 26 vs. 49%). Parity affected (P<0.01) cumulative CR at 125 d pp: 50, 43, and 31%, for 1st+2nd, 3rd+4th, and >4 lactations, respectively. The mean d from first to second service (n=205) was 41.6±1.7 and that from second to third service (n=54) was 34.2±2.9. When whole-herd DHI records were analyzed, the mean (±SE) 21-d submission rate (SR), CR, and pregnancy rate (PR) was 36.9±0.54, 32.6±0.80, and 12.4±0.34, respectively, and differed among herds. The highest and lowest CR was during winter (45.7%) and fall (35.5%). The greatest % of abortions occurred from January to April (10.2); the least from September to November (3.0). Mature cows (≥3 lactations) had a higher risk of abortion than those in their second lactation.

Key Words: Dairy Herds, Reproductive Status, Milk Progesterone

W247 Incidence and interrelation of some common hoof problems in a Southeast US dairy herd. A. H. Sanders*[1], J. K. Shearer[1], L. C. Shearer[1], S. R. van Amstel[2], D. W. Webb[1], and A. De Vries[1], [1]*University of Florida*, *Gainesville*, [2]*University of Tennessee*, *Knoxville*.

Lameness is a costly problem affecting the US dairy industry. Besides the direct costs of treatment and culling, lameness can negatively effect production, reproduction, and udder health. This study quantified hoof problems identified on a large (>2100 cows) commercial dairy farm in Georgia. Data were collected during 33 months (April 2004 to December 2006). Cows identified as lame by staff were presented for treatment to hoof trimmers certified through the Master HoofCare program (University of Florida) and employed full-time on this farm. Defects were recorded using the system recommended by the American Association of Bovine Practitioners and included superficial diseases (e.g. hairy warts), whiteline disease (WLD; 3 hoof zones), ulcers (UL; 3 hoof zones), thin soles (TS), sole punctures (SP), laminitis, and mechanical defects. Each month, between 1 and 11% of cows were treated, and treated cows averaged 1.6 problems per year. Of problems seen, 31% were WLD, 26% UL, and 12% TS. All of these were more common in the summer (July-September) than the winter (January-March; odds ratios were 0.19, 0.15, and 0.16, respectively). This is contrary to reports of lameness by season in European herds. Wet conditions, most common in winter in Europe, are more common in summer in Georgia. Leg injury (6% of treated problems), is also associated with wet/slippery conditions and was also more common in the summer (OR = 0.48). Second and later parity cows were more prone to UL, WLD, and TS than fist parity cows (OR were 0.44, 0.28, and 0.42, respectively). Incidence of WLD and UL was increased among cows with TS earlier in the same lactation. In these cows, WLD was more likely to be reported in the toe (7% increase) than in the rest of the herd. Contrary to reports that a majority of WLD is in the posterior zone, in this herd, WLD was more common farther forward. Thin soles may have been a predisposing factor, but without causing observed lameness. These data summarize some aspects of hoof health under different climate and management conditions from previous studies. Further investigation of the relationship of hoof health to other production and reproduction functions is planned.

Key Words: Lameness

W248 Economic analysis of bovine somatotropin to increase pregnancy rates in lactating dairy cows. A. A. Bell*, P. J. Hansen, and A. De Vries, *University of Florida*, *Gainesville*.

The economic value of a single injection of bovine somatotropin (bST) for improving pregnancy rate in the hot season, cold season, or year round in Florida was evaluated. bST can increase pregnancy rates in cows subjected to timed artificial insemination. A dairy farm was modeled using DairyVIP (http://dairy.ifas.ufl.edu/tools) assuming typical conditions in Florida (seasonality in milk production and probability of conception) to estimate the economic benefit of bST. Service rate at first breeding was 100% and 50% afterwards. A single injection of bST ($6 a dose) was incorporated into the first breeding protocol during the cool season (November-May), the hot season (June-October), or year round. Modeling was performed assuming that bST increased the probability of conception by 8, or 16 percentage units. Each scenario was described as (response in hot season, response in cool season). Effects of three heifer prices ($1600±400) and three milk prices ($35±9per 100 kg) were evaluated. Base probability of conception was ±5 percentage unit to determine effects of different levels of reproductive management. Profit per slot per year was determined for incremental increases in probability of conception due to the use of bST to identify the breakeven point. Default profit per slot per year (no use, no use) was $338.11 and default pregnancy rate was 19%. The economic value of the use of bST ($1600 heifer price, $35 milk price) in the scenarios of (no use,8), (no use,16), (8,no use), (16,no use), (8,8), and (8,16) resulted in a profit over the default of $4.57, 12.50, 0.33, 1.09, 4.90, and 12.84, respectively. Changes in heifer price or decreasing milk price from $35 to $26 did not change trends for profit due to bST. When milk price was increased to $44, the profit due to bST was of reduced magnitude. Farms with greater probability of conception showed lower increased profit with bST use than farms with lower probability of conception. The breakeven point was determined to be an increased probability of conception of between 3 and 4 percentage units. Results showed a positive economic benefit of using bST to increase pregnancy rates.

Key Words: Bovine Somatotropin, Profit, Pregnancy Rate

W249 Performance of beef calves weaned by traditional, fenceline, and two-step methods. D. D. Buskirk, J. M. Siegford, and B. A. Wenner*, *Michigan State University*, *East Lansing*.

Abruptly weaning calves and isolating them from their dams introduces stressors which slow growth and suppress immune function. Gradual weaning methods may reduce acute stresses of weaning, resulting in improved animal performance and welfare. A total of 227 Angus-Simmental calves from two locations, averaging 173 d of age, were allocated by weight and gender into three weaning method treatments: 1) abrupt-weaned (AW); 2) fenceline-weaned (FW); and 3) two-step-weaned (TW). On d 0, all calves were assigned to one of nine pastures and prevented from nursing their dams. Dams of AW calves were moved to remote pastures, dams of FW calves were moved to adjoining pastures with fenceline contact, and TW calves had a plastic nose flap fitted. On d 5, TW calves had the nose flap removed, and all dams were moved to remote pastures. Body weights were obtained on d 0, 5, 14, 28, and 42 for all calves. Blood samples taken on d 0, 5, 14, 28, and 42 were analyzed for plasma haptoglobin, an acute-phase protein released in response to stress stimuli. There were no significant differences in weights through d 42. Although FW calves had greater ($P<0.001$) average daily gain (ADG) between d 0 and 14 than AW and TW calves, there was no significant difference in ADG from d 0 to 42 among treatments. Haptoglobin levels were greatest on d 5, and were higher ($P<0.001$) in both AW and TW calves than FW calves (827, 1019, and 409 μg/mL, respectively). Haptoglobin returned to baseline levels by d 14. Following backgrounding, 152 calves were transported to a feedlot and allotted by weaning treatment to 21 pens. Calves were fed for an average of 207 d. Initial and final body weights were not different ($P>0.63$) among weaning treatments, nor were there differences in ADG ($P=0.60$). There was also no significant difference in the percentage of calves that received one, or two or more medical treatments during finishing. Although FW calves gained more weight and had lower haptoglobin levels shortly after weaning, there were no sustained differences in performance due to weaning method.

Key Words: Weaning, Stress, Calf

W250 A comparison of visual and palpation-based body condition scoring systems. J. M. Bewley*[1], R. E. Boyce[2], D. J. Roberts[3], M. P. Coffey[3], A. Bagnall[3], and M. M. Schutz[1], [1]*Purdue University*, *West Lafayette, IN*, [2]*IceRobotics Ltd.*, *Roslin, Scotland, UK*, [3]*3Scottish Agricultural College Dairy Research Centre*, *Dumfries, Scotland, UK*.

Body condition scoring (BCS) as an indirect measure of body fat in cattle has been widely adopted as a research and field management tool. Numerous BCS systems are utilized around the world. However, reports on how well the various systems correlate with each other are scarce. Two BCS systems were compared for assessing cows at the Scottish Agricultural College's Crichton Royal Farm. The weekly BCS were collected for a period of 12 weeks (9/5/2006-11/21/2006). Scores were obtained using the primary systems utilized within the United Kingdom (developed by Mulvany) and the United States (developed by Edmonson and Ferguson). The Mulvany (UKBCS) system involves palpation of specific body parts using a 0-4 scale. The Edmonson/Ferguson (USBCS) system is based entirely upon visual assessment using a 1-5 scale. The USBCS were obtained by the same observer each week, while UKBCS were obtained by two observers during alternate weeks. Individual scores were removed from the data set when the absolute differences with the preceding and subsequent scores were both greater than 0.25. Scores of 203 individual cows were obtained with a mean of 8.9 (±2.5) pairs of BCS per cow. Means were 2.11 (±0.36) and 2.91 (±0.39), modes were 2.25 and 2.75, and ranges were 1-3.5 and 1.5-4.5 for the UKBCS and USBCS, respectively (N=1809). The mean difference between paired observations was 0.80 (±0.26). The UKBCS and USBCS were highly correlated (r=0.766, P<0.0001). A regression equation to convert scores from the UKBCS to USBCS was developed using PROC GLM. The resulting equation was USBCS=1.6069+0.3912*UKBCS+0.1041*UKBCS^2 (R^2=0.59). This equation may be used to interpret scores within the literature obtained using these two BCS systems, though the equation should be corroborated with other scorers.

Key Words: Body Condition Scoring, International Comparison

W251 Effect of discontinuous roughage delivery in a feedlot diet on liveweight gain and feed efficiency of beef steers. M. Avila[3], J. I. Arroquy*[1,2], and J. J. Saravia[1], [1]*INTA Santiago del Estero*, *Santiago del Estero, Argentina*, [2]*Consejo Nacional de Investigaciones Científicas y Técnicas*, *Argentina*, [3]*Universidad Nacional de Santiago del Estero*, *Santiago del Estero, Argentina*.

The objective of this study was to evaluate the effect of feeding a total mixed ration compared to feeding the roughage portion of the diet once every 2-d and separated from the daily concentrate mix. Thirty beef steers (Braford, Criollo, and Braford × Criollo; initial body wt = 259 ± 27 kg) were used in a 69-d study. Treatments were: a total mixed ration (TMR) and the same proportion of ingredients but roughage offered once every 2-d and separated of the daily delivered concentrate portion of the diet (roughage every other day, REOD). Treatments were arranged in a completely randomized design (three pens/ treatment). Steers were fed ad libitum once a day. In both treatments diet had the following proportion of feedstuffs, 10% grass hay, 82% dry ground corn, 7% ground cottonseed, 0.65% urea, and 0.35% mineral-salt mix. But in REOD the amount of hay delivered once every 2-d was twice the quantity of hay daily offered in TMR. Final body weight did not differ between treatments (final liveweight = 331 ± 26 kg). Average daily gain did not differ among treatments (1013 vs. 1080 g/d for TMR vs. REOD respectively; SEM = 95 g/d). Intra-pen variability for ADG was similar between TMR and REOD. Dry matter intake was significantly greater in TMR compared to REOD (dry matter intake, 8.53 vs. 6.77 kg/d for TMR vs. REOD; $P < 0.01$). Gain to feed ratio tended to be better for REOD than TMR (0.15 vs. 0.13 kg of gain/ kg of DM for REOD vs. TMR; $P = 0.07$). The proportion of concentrate in the ingested diet did not differ between treatments (86.9 vs. 85.5% for TMR vs. REOD). However, steers in REOD adjusted the proportion of ingredients selecting grass hay (14.4% REOD vs. 13.0% TMR; $P < 0.01$). Steer in REOD selected a diet with a lower concentration of fiber (31.2 vs. 31.7% NDF for REOD and TMR respectively; $P < 0.01$) and a higher concentration of CP (14.6 vs. 14.2% CP for REOD and TMR respectively; $P < 0.01$). In conclusion, steers fed a separated roughage source once every 2-d had similar liveweight gain and tended to be more efficient in feedstuff use compared to a TMR delivered daily.

Key Words: Forage Delivery, Gain, Feed Efficiency

W252 Simulation model of fat deposition and distribution in beef steers: 1. Empirical models converting fat thickness to subcutaneous fat and KPH to visceral fat. M. J. McPhee*[1,2], J. W. Oltjen[1], J. G. Fadel[1], D. Perry[2], and R. D. Sainz[1], [1]*University of California*, *Davis*, [2]*NSW DPI*, *Armidale, Australia*.

Empirical models were developed to convert carcass characteristics into kilograms of fat or vice versa to be used in the Davis Growth Model of fat deposition and distribution in beef steers. Allometric equations ($y = ax^b$) that include frame size (1 to 9) were developed between: 12th-rib fat thickness (fat thickness, mm) and subcutaneous fat (kg); and between KPH (kg) and visceral fat (kg). The results of the non-linear regression were: subcutaneous fat, kg = (frame size × fat thickness, mm)$^{0.79}$ ($n = 12$; $P < 0.01$) with $R^2 = 0.99$ and SE = 0.36; and visceral fat, kg = $3.92 \times KPH^{0.87}$ ($n = 28$; $P < 0.01$) with $R^2 = 0.99$ and SE = 0.032. Several techniques were used to evaluate the model: (a) mean bias (observed – model-predicted); (b) modeling efficiency (values close to 1 indicate a perfect model and values < 0 indicate a very poor model); (c) Kolmogorov-Smirnov (KS) 2-sample test; and (d) linear regression. The KS was a test of the hypothesis that the observed and model-predictions have the same parent distribution. The linear regression tested slope = 1 intercept = 0 and bias using the simultaneous F-statistic for both slope = 1 and intercept = 0. The results were: mean bias of 2.90 and -1.65 kg; modeling efficiency of 0.59 and 0.85, for subcutaneous and visceral fat respectively; the KS test indicated that the observed and model-predicted values were from the same parent distribution for both subcutaneous and visceral fat and the linear regression indicated that there was some bias ($P = 0.02$ and $P < 0.01$, for subcutaneous and visceral fat, respectively). The inclusion of frame size is an important addition to the subcutaneous fat vs. fat thickness (mm) model. Further evaluation and improvements are required before the equations are incorporated into the Davis Growth Model.

Key Words: Cattle, Subcutaneous, Visceral

W253 Simulation model of fat deposition and distribution in beef steers: 2. Empirical models to initialize fat deposition models. M. J. McPhee*[1,2], J. W. Oltjen[1], J. G. Fadel[1], and R. D. Sainz[1], [1]*University of California*, *Davis*, [2]*NSW DPI*, *Armidale, Australia*.

Empirical models were developed to predict initial conditions for first-order differential equations to be used in the Davis Growth Model of fat deposition and distribution in beef steers. Allometric equations ($y = ax^b$) were developed between: empty body weight (EBW) for both DNA (g) and fat contribution (FC, %) for four fat depots: intermuscular (INTER), intramuscular (INTRA), subcutaneous (SUB), and visceral (VIS). The results for DNA were: INTER = $0.005\times(EBW)^{0.63}$; INTRA = $0.00000751\times(EBW)^{1.46}$; SUB = $0.000213\times(EBW)^{1.01}$ (n = 20; $P < 0.01$), and VIS = $0.12\times(RA)^{-0.11}$ (n = 20; P = 0.71) with $R^2 = 0.81$, 0.84, 0.74, and 0.04 and SE = 0.06, 0.13, 0.12, and 0.10, respectively; and FC were: INTRA = $155.66\times(EBW)^{-0.46}$; SUB = $3.24\times(EBW)^{0.39}$ (n = 21, 66; $P < 0.01$), and VIS = $52.22\times(EBW)^{-0.16}$ (n = 66; P = 0.89) with $R^2 = 0.66$, 0.55, and 0.09 and SE = 0.26, 0.12, and 0.17, respectively; INTER FC was found by difference. The models were challenged with independent data sets (INTER, INTRA, SUB, and VIS with n = 6, 5, 6, and 6 for DNA challenge; and n = 9, 9, 9, and 9 for FC challenge, respectively). Several techniques were used to evaluate the model: (a) mean bias (MB, observed – model-predicted); (b) modeling efficiency (MEF, values close to 1 indicate a perfect model and values < 0 indicate a very poor model); (c) Kolmogorov-Smirnov (KS) 2-sample test; and (d) linear regression. The KS was a test of the hypothesis that the observed and model-predictions have the same parent distribution. The linear regression tested slope = 1, intercept = 0, and bias using the simultaneous F-statistic for both slope = 1 and intercept = 0. The results for the DNA challenge were: MB of 0.03, -0.02, 0.02, and 0.02 g; the results for the FC challenge were: MB of 3.44, -1.72, -0.57, and -1.15 kg; and MEF of 0.64, 0.04, 0.84, and 0.68 for INTER, INTRA, SUB, and VIS, respectively; the KS test indicated that the observed and predicted values were from the same parent distribution. The linear regression for FC indicated that bias ($P < 0.01$) only existed for INTRA fat. These equations will be used to initialize the DNA and fat depot differential equations in our ongoing program for modeling beef cattle growth and carcass quality.

Key Words: Differential, DNA, Fat

W254 Pasturing to decrease greenhouse gas emissions from feedlot cattle operations: A whole system approach. H. Koknaroglu[1], T. Akunal[1], T. Purevjav*[2], and M. P. Hoffman[2], [1]*Suleyman Demirel University*, *Isparta, Turkey*, [2]*Iowa State University*, *Ames*.

A three-year study integrating pasture and drylot feeding systems was used to assess effect of pasturing on greenhouse gas emission from cattle operations. For this purpose, each year, 84 fall-born and 28 spring-born calves of similar genotypes were used. Fall-born and spring-born calves were started on test in May and October, respectively. Treatments were: 1) fall-born calves directly into feedlot; 2 and 3) fall-born calves put on pasture with or without an ionophore and moved to the feedlot at the end of July; 4 and 5) fall-born calves put on pasture with or without an ionophore and moved to the feedlot at the end of October; 6 and 7) spring-born calves put on pasture with or without an ionophore and moved to the feedlot at the end of October. In the feedlot, steers were provided an 82 % concentrate diet containing whole-shelled corn, ground alfalfa hay, ionophore and molasses. Pens of cattle were harvested at approximately 522 kg. Research conducted on greenhouse gas emission generally measures carbon dioxide (CO2), methane (CH4) and nitrous oxide (N2O) emissions in feedlot or on pasture. In this study we considered CO2 sequestered by pastures. CH4 production in the feedlot and on pasture was calculated by multiplying gross energy of feed consumed and percent of gross energy converted to CH4. N2O production on pasture was calculated by using the actual nitrogen fertilizer amount and percent of nitrogen converted to N2O on pasture. Fall-born cattle directly going into feedlot and spring-born cattle grazed for nearly a month had greenhouse gas emission of 2285 and 1029 kg per head CO2 equivalent, respectively. Cattle grazed until July and October sequestered more CO2 equivalent then they emitted meaning that they did not contribute to global warming. Net CO2 equivalent sequestered increased as time on pasture increased ($P<0.05$). Results show that pasturing is an important method to decrease greenhouse gas emission from cattle operations and when calculating the greenhouse gas emission from cattle operations, the amount of greenhouse gas sequestered by pastures should be taken into consideration.

Key Words: Global Warming, Greenhouse Gas, Feedlot Cattle

W255 Evaluation of a delayed-release anabolic implant in finishing steers. W. Nichols[1], J. Hutcheson[1], D. Yates[1], M. Streeter[1], D. Smith*[2], and M. Brown[2], [1]*Intervet, Inc.*, *Millsboro, DE*, [2]*West Texas A&M University*, *Canyon*.

Two experiments were conducted to evaluate the efficacy of a delayed-release implant. In Exp. 1, 360 yearling steers (177 d on feed) were assigned to either no implant, Revalor-IS (80 mg trenbolone acetate [TBA] and 16 mg estradiol [E]) on d 1 and a reimplant of Revalor-S (120 mg TBA and 24 mg E) on d 75 (IS/S), or Revalor-XS on d 1 only (XS; 200 mg of TBA and 40 mg of E). All cattle were removed from their home pen and moved through the handling facility on d 75. Overall ADG was 23.1% greater, DMI was 10.7% greater, and feed efficiency was improved by 10.1% ($P < 0.01$) for implanted steers. Dressing percent was greater ($P < 0.01$) for implanted than for non-implanted steers; implanting resulted in 38 kg more carcass weight ($P < 0.01$). Implanted steers had a larger LM area, greater rib fat thickness, more body fat, a higher average yield grade, but a lower marbling score ($P < 0.04$) than non-implanted steers. Growth performance and carcass characteristics did not differ between IS/S and XS ($P > 0.05$). Implanted steers produced fewer carcasses grading at least low Choice ($P < 0.01$; 45% vs 69%), but carcass quality did not differ among IS/S and XS. In Exp. 2, 720 steer calves at three locations were assigned to receive XS on d 1 only or sham implanting on d 1 (198 d on feed). Steer ADG was 19.9% greater and DMI was 10.5% greater ($P < 0.05$) for XS; feed efficiency was improved ($P < 0.05$) by 7.3% for XS. Dressing percent was similar across treatments (P = 0.16). Steers receiving XS produced carcasses that were 34 kg heavier, had a larger LM area, more external fat, a higher average yield grade, and more body fat ($P < 0.01$) than sham-implanted steers, but marbling score was similar across treatments. The number of carcasses grading at least low Choice was slightly reduced (P = 0.05) by XS (62% vs 69%). Steers receiving XS on d 1 only performed as well as steers given Revalor-IS/S. Implanting steers fed for 198 d on d 1 only with XS resulted in more carcass weight at slaughter, improved feed efficiency by 7%, and resulted in slightly fewer carcasses grading at least low Choice than non-implanted steers.

Key Words: Growth Promotant, Anabolic Implant, Implant Payout

W256 Temperament, assessed upon feedlot entry, did not impact performance of Texas A&M Ranch to Rail steers. K. O. Curley, Jr.*[1], J. J. Cleere[2], J. C. Paschal[3], T. H. Welsh, Jr.[1], and R. D. Randel[4], [1]*Texas Agricultural Experiment Station*, *College Station*, [2]*Texas Cooperative Extension*, *College Station*, [3]*Texas Cooperative Extension*, *Corpus Christi*, [4]*Texas Agricultural Experiment Station*, *Overton*.

As poor temperament negatively impacts multiple facets of cattle production an investigation of the linkage between cattle behavior and economic endpoints within the beef industry is warranted. The objective of this study was to identify any relationship of exit velocity (EV) measures obtained at entry to the feedlot with subsequent growth performance. Exit velocity measured during processing of 161 steers at a south Texas feedlot was utilized to identify calm (C; those slower than 0.5 SD below the mean EV; n = 55) and temperamental (T; those faster than 0.5 SD above the mean EV; n = 49) steers. At this time the cattle were weighed, tagged, implanted, vaccinated and sorted by weight (45 kg increments) into lots for feeding. Cattle were evaluated for USDA frame and muscle score and assigned an initial value. Animals were from various ranches (n = 6) and of variable breed types, both ranch of origin and Brahman influence (identified as greater than 1/8) were incorporated into statistical analyses. Linkage between temperament and stress physiology was confirmed as serum cortisol concentrations differed ($P < 0.01$; C = 6.40 ± 1.59, T = 11.77 ± 1.59 ng/ml) with temperament. Initial BW differed ($P < 0.01$) with temperament as the calm steers were heavier upon arrival to the feed yard (C = 310 ± 17, T = 256 ± 17 kg). The length of the feeding period differed ($P < 0.05$) with temperament as temperamental steers were fed longer (C = 207.0 ± 2.0, T = 214.0 ± 2.0 d). Weight gain of the steers differed with temperament ($P < 0.01$; C = 280 ± 15, T = 324 ± 15 kg), but the final BW did not ($P = 0.53$). While the initial value was greater for the calm steers ($P < 0.02$; C = $576.65 ± 27.30, T = $508.11 ± 27.30) the compensatory gain exhibited by the temperamental cattle contributed to no difference ($P = 0.94$) in the net income received from each of the temperament groups. Although temperament appraisals at weaning have been identified as a possible indicator of post-weaning growth, exit velocity measured upon arrival to the feedlot was not indicative of steer performance during the feeding period.

Key Words: Temperament, Exit Velocity, Feedlot Performance

W257 Effect of frame score on performance and carcass characteristics of steers finished in the feedlot or backgrounded for various time on pasture and finished in the feedlot. H. Koknaroglu[1], T. Akunal[1], T. Purevjav*[2], and M.P. Hoffman[2], [1]*Suleyman Demirel University*, *Isparta, Turkey*, [2]*Iowa State University*, *Ames*.

A three-year study integrating pasture and drylot feeding systems was used to examine effect of frame score on performance and carcass characteristics of steers. Each year, 84 fall-born and 28 spring-born calves of similar genotypes were used. Fall-born and spring-born calves were started on test in May and October, respectively. Treatments were: 1) fall-born calves directly into feedlot; 2 and 3) fall-born calves put on pasture with or without an ionophore and moved to the feedlot at the end of July; 4 and 5) fall-born calves put on pasture with or without an ionophore and moved to the feedlot at the end of October; 6 and 7) spring-born calves put on pasture with or without an ionophore and moved to the feedlot at the end of October. Frame scores were determined by taking steersâ€™ age and live weight into consideration. Cattle that grazed the same duration on pasture were regarded as the same treatment regardless of whether they received an ionophore or not. In the feedlot, steers were provided an 82% concentrate diet containing whole-shelled corn, ground alfalfa hay, and a protein, vitamin and mineral supplement containing ionophore and molasses. Pens of cattle were harvested at approximately 522 kg. Cattle having a higher frame score at the entry to pasture and grazed until July and October tended to have higher and lower daily gain on pasture than those having lower frame score, respectively ($P>0.05$). Fall-born and spring-born cattle grazed until October, which had higher frame scores at the entry to pasture tended to have higher daily gain in the feedlot showing a compensatory growth. In the feedlot, within each treatment cattle having higher frame score tended to have higher daily gain ($P>0.05$) and had higher dry matter intake ($P<0.05$). Results showed that cattle with higher frame scores had higher growth potentials in the feedlot and if the grazing season is extended then daily gain of cattle having higher frame score decreases.

Key Words: Feedlot Cattle, Frame Score, Pasture

Ruminant Nutrition III

W258 Biological treatment of peanut hay as ruminant feed. B. Borhami*[1], S. Soliman[2], M. EL-Adawy[1], E. Ghonaim[2], M. Yacout[3], and H. Gado[4], [1]*Department of Animal Production, Faculty of Agriculture, Alexandria Univ.*, *Alexandria, Egypt*, [2]*Central Lab for food and Feed (CLFF), Ministry of Agriculture, Dokki*, *Gizza, Egypt*, [3]*Animal Production Research Institute, Ministry of Agriculture, Dokki*, *Gizza, Egypt*, [4]*Department of Animal Production, Faculty of Agriculture, Ain Shams Univ.*, *Cario, Egypt*.

This work was carried out to evaluate the effect of two biological treatments on the nutritive value of peanut hay (PNH). Three Barki rams and three ewes (fitted with permanent rumen fistula) were used for the digestibility and rumen fermentation trials, respectively. Six crossbred Friesian cows were used for the lactation trial. All animal were fed a restricted amount of commercial concentrate and ad libitum PNH either untreated (control) or treated with Tricoderma viride or ZAD probiotic. Higher crude protein content and higher losses in fiber, except for hemicellulose, were observed with the treated PNH. Total digestible nutrients ranged between 55.8 and 64.62% for control or fungi treated diets, respectively. Highest values of nitrogen balance were observed with the ZAD probiotic diet and the lowest value was observed in sheep fed the control diet. Rumen ammonia concentration and its rates of production were significantly ($P<0.05$) higher with ZAD probiotic. VFA were significantly higher ($P<0.05$) with fungi treatment than other diets. Milk production was increased with the fungi and ZAD diet. Biological treatment leads to increase milk fat and total solids compared with the control diet. Long term feeding of such material with analysis of metabolites (blood and milk) of animals fed such material is necessary.

Key Words: Biological, Sheep, Peanut Hay

W259 Predicting intake of maize stover by sheep using near infrared reflectance spectroscopy. S. Fernandez-Rivera*, D. Negassa, J. Hanson, and G. Gebremariam, *International Livestock Research Institute*, *Addis Ababa, Ethiopia*.

Near infrared reflectance spectroscopy (NIRS) equations were developed to predict digestible organic matter intake (DOMI, g/kg $LW^{0.75}$) of maize stover by sheep. Stover or husk from eight maize cultivars grown in three field replicates in 2003 and stover from 12 cultivars grown in four field replicates in 2004 were used in three growth trials of 83-98 d. Diets consisted of 80% stover or husk and 20% supplement, contained 10.5% CP and were offered ad libitum to allow stover refusals of 20-25%. Nine or 12 individually fed sheep were used per cultivar (three sheep per field replicate). Sixty-eight diets were used for calibration and 28 for validation. Three samples were prepared for each diet: 1) WS, consisting of whole stover or husk; 2) SS, consisting of WS sieved to remove the exact proportion of stover refused in an attempt to account for the effect of diet selectivity; and 3) SS+S, made of SS and supplement in the proportions consumed by the sheep. Absorbance was determined from 1100 to 2498 nm at intervals of 2 nm in a FOSS NIR System Model 5000. Principal component analyses using a mathematical treatment 1, 4, 4, 1 were used for calibration. Best calibration parameters were obtained with WS (Table 1). Validation R^2 and SE of predictions (SEP) were 0.82 and 2.81 for WS; 0.82 and 3.04 for SS; and 0.87 and 2.34 for SS+S. DOMI of validation diets was predicted with acceptable levels of precision using WS. No gain in precision was observed by using SS, but R^2 increased by 0.05 and SEP decreased by 0.47 by sieving the residue and adding the supplement in the proportions consumed.

Table 1.

	WS	SS	SS+S
n	68	68	67
SEC	1.98	2.29	2.18
R^2	0.89	0.85	0.85
SECV	2.06	2.40	2.34

SEC=SE of calibration; SECV=SE of cross-validation

Key Words: Maize, NIRS, Sheep

W260 Energy costs of steam-flaking corn with different chemical grain conditioning agents. A. T. Moore*[1], C. R. Richardson[1], J. M. Harris[2], G. V. Pollard[3], and D. C. Boyles[1], [1]*Texas Tech University*, *Lubbock*, [2]*Westway Feed Products, Inc.*, *Tomball, TX*, [3]*Texas State University*, *San Marcos*.

The effects of the addition of water only, or grain conditioning agents on the electrical and gas energy costs to steam-flake corn were determined in a randomized block design. Treatments were: A-water; B-Sur-Flake®; C-whey plus Sur-Flake; D-glycerol plus Sur-Flake; and E-whey plus glycerol plus Sur-Flake. Treatments were evaluated by time block during days (A.M. and P.M. blocks) and were randomly steam-flaked across five days, for a total of 50 determinations. U.S. No. 2 grade corn was obtained in one quantity through the local grain trade in the High Plains area of Texas. Corn was cleaned with a scalper cleaner prior to the conditioning and steam-flaking. All treatments were added to 45.5 kg batches of corn by mixing of six percentage points of moisture and left to stand for 18 h before steam-flaking. The conditioned grains were steamed for 20 min in a 15.24 cm diameter round chamber. Immediately after steaming, treatments were flaked and electrical energy usage was measured. Gas used for generating steam was the same ($.862 per 45.5 kg) for each treatment batch and was used to calculate total energy costs for processing. Electrical energy costs for flaking were not different (P = 0.845) as analyzed by SAS. In conclusion, type of grain conditioning agent may affect rate of moisture uptake, economics of the flaking process, and durability of flakes. Results from this experiment show that electrical energy costs of flaking varied by as much as 11%.

Table 1. Total electrical and gas cost ;per 45.5 kg

Treatment	Block A	Block B
A	$.991	$1.009
B	$.984	$.986
C	$1.007	$1.007
D	$.996	$.996
E	$1.006	$1.002

Key Words: Steam-Flaking, Corn, Grain Conditioners

W261 Determining optimum density of steam-flaked corn for feedlot heifers. M. L. May*, M. J. Quinn, B. E. Depenbush, and J. S. Drouillard, *Kansas State University*, *Manhattan*.

The purpose of the experiment was to determine optimum density (FD) of steam-flaked corn for beef finishing diets. Diets consisted of corn flaked to densities of 360, 411, or 462 g/L (28, 32 or 36 lb/bu, respectively). Cattle were randomly allotted to 48 feedlot pens (16 pens per treatment) with 6 to 8 animals in each pen (n=358; initial BW = 337 ± 1.22 kg). Animals were fed finishing diets for 115 d. There were no significant differences among treatments with respect to DMI; ADG; efficiency; carcass weight; dressing percent; quality grade; yield grade; fat over the 12th rib; kidney, pelvic, and heart fat; or longissimus muscle area (P > 0.10), though performance was numerically decreased when corn was less extensively processed. Mill efficiency improved as density of flaked grain increased (P < 0.01), which was driven primarily by increases in mill throughput. Particle size of processed corn and the complete diets increased as FD increased (P < 0.01). Percentages of available starch were 46.73, 39.27, and 34.87 for FD of 360, 411, and 462 g/L, respectively (P < 0.01). The increase in mill production would support increasing FD; however decreases in animal performance, though small, may offset economic benefits attributed to greater mill capacity.

Table 1.

Item	28	32	36	SEM	P-Value
DMI, kg	7.63	7.67	7.70	0.08	0.81
ADG, kg	1.29	1.27	1.27	0.04	0.55
G:F	0.169	0.166	0.161	0.004	0.31
HCW, kg	308	307	305	2.27	0.72
Choice, %	61.0	54.5	58.2	4.98	0.65
Yield grade, avg	2.69	2.62	2.75	0.06	0.29
Processing, kg/hr	2224	2536	3397	281.08	<0.01
Diet particle size, µm	2290	4420	4565	284.08	<0.01
Flake particle size, µm	6163	6565	7000	55.23	<0.01

Key Words: Steam-Flaked Corn, Finishing Cattle

W262 Influence of dietary crude protein concentration on pancreatic α-amylase and trypsin activities in feedlot steers. K. C. Swanson*, H. Salim, Y. Wang, S. Holligan, M. Z. Fan, and B. W. McBride, *University of Guelph*, *Guelph, ON, Canada*.

Twenty-four yearling beef steers (initial BW=510±4.9 kg) predominately of Angus breeding were used in a randomized complete block design to determine the effect of dietary CP concentration on pancreatic α-amylase and trypsin activities. Treatment diets were formulated to contain 8.8, 11.0, 13.2, and 15.4% CP. Soybean meal and TOP SOY™ (bypass soybean meal) were used as supplemental protein sources to assure that metabolizable protein intake was increased with increasing dietary CP concentrations. Steers were individually fed at 2.5×NE_m requirement using Calan gates. Steers were penned in groups of four (1 per treatment) and fed experimental diets for 28 d before tissue collection. Four steers (1 pen) were slaughtered per wk. Pancreata were weighed, subsampled, frozen in liquid N, and stored at -80°C until analyses for protein, and α-amylase, and trypsin activities. Pancreatic weight (g and g/kg BW) did not differ between treatment groups. Pancreatic protein (mg/g and g/pancreas) increased linearly (P≤0.09) with increasing dietary CP concentration. Pancreatic α-amylase activity (U/g, U/g protein, U/pancreas, and U/g pancreas/kg BW) increased linearly (P≤0.01) with increasing dietary CP concentration. Pancreatic α-amylase activity (U/g, U/g protein, U/pancreas, and U/g pancreas/kg BW) also tended to respond quadratically (P≤0.15) with the greatest α-amylase activity observed in the 13.2% CP treatment. Pancreatic trypsin activity (U/g, U/g protein, U/pancreas, and U/pancreas/kg BW) increased linearly (P≤0.09) with increasing dietary CP concentration. These data indicate that increasing dietary CP concentration increases the concentration and content of pancreatic α-amylase and trypsin activities which may increase the capacity to digest starch and protein in the small intestine. However, this response may plateau for α-amylase as high dietary CP concentration (15.4% CP) did not elicit an additional increase in the concentration or content of α-amylase.

Key Words: Feedlot Cattle, α-Amylase, Trypsin

W263 Effects of dexamethasone administration and Revalor-S® on growth, carcass characteristics and visceral organ and fat mass of finishing beef steers. S. E. Kitts*, C. C. Taylor-Edwards, D. B. Edwards, J. B. Cannon, A. F. Beckemeyer, K. E. Earing, D. L. Harmon, E. S. Vanzant, and K. R. McLeod, *University of Kentucky*, *Lexington*.

Administation of dexamethasone (DEX), a synthetic glucocorticoid, has been shown to alter site and rate of fat accretion in several mammalian species, including cattle. Accordingly, this experiment was designed to determine the potential interaction between DEX and trenbolone acetate/estradiol (Revalor-S®) administration on growth performance, carcass characteristics and visceral organ and fat mass of finishing beef steers. One hundred forty-four crossbred steers (428 ± 4 kg) were assigned randomly to a 2 x 2 factorial arrangement of treatments consisting of either no implant or Revalor-S® implant on d 1 and either no or i.m. injection of 0.09 mg/kg BW DEX on d 1, 28, and 56. Steers received ad libitum amounts of a 90:10 concentrate-forage diet during the feeding period and were slaughtered (n=112) on d 84 for determination of carcass quality. A subset of steers (8/treatment) was slaughtered on d 84 and 86 for determination of visceral organ and fat mass. Over the feeding period, DMI (0.4 kg/d) and efficiency of gain (16%) were greater ($P \leq 0.05$) in steers receiving implant compared to those receiving no implant. In the presence of implant, DEX reduced ADG, whereas in the absence of implant, DEX had no effect (interaction, $P = 0.05$). There were no effects of treatment on carcass characteristics except DEX tended to increase ($P = 0.10$) dressing percentage. Steers receiving implants tended ($P = 0.10$) to have heavier rumen + reticulum weights as a percentage of empty BW compared to those receiving no implant. Administration of DEX increased ($P \leq 0.05$) liver and pancreas weights as a function of empty BW and increased omental fat mass for steers in the absence, but not the presence of implant (interaction, $P = 0.006$). In summary, Revalor-S® increased DMI and efficiency of gain; however, DEX partially attenuated the positive effects of implant on ADG and increased omental fat mass in the absence of implant.

Key Words: Cattle, Dexamethasone, Implant

W264 Effects of ractopamine HCl and steroid implants on feedlot performance and carcass characteristics of cull beef cows. K. W. Harborth*, T. T. Marston, J. A. Unruh, and B. J. Johnson, *Kansas State University*, *Manhattan*.

The marketing of cull cows can potentially contribute 10-25% of cow/calf operations gross income. Increasing the lean tissue and quality grade of cull cows could increase their market potential profitability. A study was conducted utilizing thirty-two open crossbred cows in a 2 × 2 factorial experiment to determine the effects of feeding ractopamine HCl (Optaflexx®, Elanco, at 300 mg•head- 1•d-1 for 28 d) and steroid implants (Revalor® 200, Intervet, 60d) on feedlot performance and carcass composition. Cows were blocked by weight (heavy and light) and randomly assigned to one of four serial slaughter groups. Following a warm-up period cows were individually fed an ad libitum 86% concentrate diet (CP = 14.63%, NEm = 2.12 Mcal/kg, NEg = 1.46 Mcal/kg) for 60 d. Within slaughter groups cows were allotted to treatment combinations. The combinations were: 1) Control (no implant or ractopamine HCl); 2) Implant (implanted only); 3) ractopamine HCl (ractopamine fed only); or 4) Combination (implanted and fed ractopamine). There were no significant differences in average daily. Implanted cows had greater dressing percentages (P = 0.06), and red meat yields 10 kg greater than non implanted cows (P = 0.06). Optaflexx treated cows had greater kidney, pelvic, heart fat percentages (P = 0.05). This study showed that implanting cull cows with Revalor-200 and/or feeding ractopamine HCl during the last 28 days on feed had minimal effects on performance and carcass characteristics of cull cows fed a high concentrate diet for 60 d.

Key Words: Cull Cows, Ractopamine, Steroid Implants

W265 Effect of age on feedlot performance and carcass characteristics of cull beef cows. K. W. Harborth*, T. T. Marston, J. A. Unruh, and B. J. Johnson, *Kansas State University*, *Manhattan*.

Data from thirty-one open crossbred cull beef cows fed a high concentrate diet for 60 d was used to investigate the effect of cow age on live animal performance, carcass composition, and subprimal yield. Cows were sorted into two age groups young (≤ 5 years of age, n= 16) and mature (≥ 6 years of age, n = 15). Mature cows were only slightly heavier than young cows initially. Young cows gained 0.9 kg/d more

than mature cows (P = 0.001). Young cows had greater DDMI, and feed efficiencies (P ≤ 0.05) during the duration of a 60 d feeding period. Young cows had heavier hot carcass weights (P < 0.001), and greater dressing percentages (P < 0.001) than older cows. Young cows had larger longissimus muscle area (P < 0.001) than mature cows. There were no differences between young and mature cows for adjusted 12th fat rib fat thickness and USDA yield grade. Young cows had greater quality grades (P = 0.001) primarily because of lower maturity scores (P < 0.01). Young cows also had greater ribeye roll, strip loin, tenderloin, inside round, outside round, eye of round, and knuckle weights when compared to mature cows. While there was no difference in lean trim weights (P = 0.51) between mature and young cows, young cows had significantly greater fat trim weights (P = 0.02) which may have influenced the difference in dressing percentage. Mature cows had greater initial values due to their weight advantage (P < 0.01), but younger cows had lower cost of gains (P < 0.01), greater final live market (P < 0.01) and net values (P < 0.01) when compared to the mature cows. These data indicate young cull cows were more profitable in a 60 d feeding period than older, mature cows.

Key Words: Cull Beef Cows, Age, Feedlot Performance

W266 Adding neem oil to a feedlot diet modulated proportions of volatile fatty acids and increased microbial protein synthesis in a continuous culture. W. Z. Yang*[1], J. Laurain[2], and B. Ametaj[3], [1]*Research Centre, Agriculture and Agri-Food Canada*, *Lethbridge, Alberta, Canada*, [2]*National Engineering School of Agronomy and Food Sciences*, *Nancy, France*, [3]*Department of Agricultural, Food and Nutritional Science, University of Alberta*, *Edmonton, Alberta, Canada*.

Neem oil is a commercialized product that has been shown to have antibacterial, antifungal and antiparasitic activities in different species. A dual effluent continuous culture system was used to investigate the effects of addition of neem oil in a feedlot diet on rumen fermentation, digestibility and microbial protein synthesis. The experiment was designed as a replicated 3 x 3 Latin square with the following treatments: control (no neem oil), low (3%) and high (6%) level of neem oil (DM basis). The experimental diet consisted of 84% barley grain, 9% barley silage, and 7% supplement (DM basis). Mean ruminal pH (6.08) and total VFA (82.1 m*M*) concentration were not affected by supplementation of neem oil. However, increasing the amount of neem oil tended to decrease ($P < 0.10$) proportion of acetate (45, 44, and 40%), increased ($P < 0.09$) proportion of butyrate (6.3, 6.9, and 9.5%) and had no affect on proportion of propionate (45%) for control, low and high levels of neem oil, respectively. As a result, the ratio of acetate to propionate decreased numerically ($P < 0.15$) with increasing the amount of neem oil. Ruminal digestibilities of DM (79, 77, and 70%), NDF (65, 64, and 56%) and starch (89, 85 and 82%) decreased ($P < 0.01$), whereas degradability of N (66, 82, and 74%) was increased ($P < 0.06$) in relation to the amount of neem oil added. Supplementing 3% neem oil increased microbial protein synthesis by 25% with no further increase with the addition of 6% neem oil. These results indicate that adding 3% neem oil in a feedlot diet modulated VFA profiles as well as increased ruminal N degradation and microbial protein synthesis. Increasing further the amount of neem oil (i.e., at 6%) had no beneficial effect on ruminal digestion.

Key Words: Neem Oil, Fermentation, Continuous Culture

W267 Fat tissue deposition and plasma hormone concentrations in early Angus–Nellore cattle treated with recombinant bovine somatotropin (rbST). C. L. Martins, R. C. Cervieri, M. D. B. Arrigoni, A. C. Silveira, C. A. Oliveira, D. D. Millen*, R. D. L. Pacheco, H. N. Oliveira, and L. A. L. Chardulo, *FMVZ/UNESP Botucatu*, *São Paulo, Brazil*.

The objective was to study the response of rbST on fat tissue deposition and plasma concentrations (PC) of thyroid hormones (T3 and T4), IGF–I and leptin (LE) in early Angus–Nellore cattle. We used 40 male calves, 20 d old, supplemented with creep feed until weaning (WE), and divided in two groups(n=20, 0.10mg/hd/d, every 14 d; n=20, not treated). The animals were weaned at 210 d old and fed in feedlot (FE), where they were housed and divided in four treatments keeping the same dose every 14 d until 100 d prior to slaughter (n=10, treated with rbST before and after WE; n=10, treated with rbST until WE; n=10, treated with rbST after WE; n=10, not treated with rbST). Back fat thickness (BFT) by ultrasound and PC were measured every 28 d. BFT did not differ (P>0.05) in the WE and FE periods (1.0 and 5.3mm, respectively). Treated calves presented higher (P<0.05) IGF–I and T4 PC (282.38 vs. 171.88ng/ml and 8.16 vs. 7.22µg/dL, respectively) than animals not treated in the end of the WE period, but PC in the FE period did not show significance for any treatments. For LE, no significant effect of the treatments and theirs interactions were observed (P>0.05), showing a constant PC during the experimental period. But, the LE concentration increased from the beginning to the end of the experiment (P<0.05), independent of treatments (3.098 vs. 7.996ng/mL) and fat tissue amount (P<0.05), from 18.7% (WE period) to 30.4% (FE period). T3 concentration did not differ (rbST=2.563 vs. Control=2.227µg/dL) in the WE period, but differed (P<0.05) in the FE period, when the animals which received rbST in the WE period presented a lower T3 concentration. We did not observe a correlation among BFT, T3, T4, IGF–I and LE in the periods tested. In the WE period the rbST showed advantage for not altering the fat tissue deposition. The hormones studied showed normal secretion as the animals got older, with increasing LE concentration as the BFT got thicker. Leptin showed to be a good metabolic indicator of animal adiposity, being able to be utilized to predict body condition score.

Key Words: Hormones, rbST

W268 Influence of concentrate supplements on performance of grazing growing steers during the dry season, in tropical pastures. R. H. T. B. Goes*[1], R. P. Lana[2], D. D. Alves[3], A. B. Mancio[2], and T. B. Freitas[2], [1]*Universidade Federal da Grande Dourados*, *Dourados, MS, Brasil*, [2]*Universidade Federal de Viçosa*, *Viçosa, MG. Brasil*, [3]*Universidade Estadual de Montes Claros*, *Janauba, MG, Brasil*.

The experiment was conducted to evaluated the effects of supplements on performance of growing cattle, in *Brachiaria brizantha* cv Marandu pasture during the dry season. Fifty-four crossbred, castrated steers, with initial weight of 271 kg, were distributed at random in five paddocks of 60.000 m^2. The supplements were fed at crescent levels of 0, 0.4, 0.80, 1.8 and 2.60 kg of supplement/animal/day, and were based in a mineral mixture (100, 16, 8.0, 4.0 and 2.0%), urea (0, 18, 17, 7 and 7 %), soybean meal and corn meal. The protein sources were used in the amount necessary to reach approximately a diet of 13% of crude protein. The animals were weighted at intervals of the 21 days. The average daily gain (ADG) in function of the supplement levels presented a linearly response (ADG = 0.132x + 0.151, $r^2 = 0.84$), with

the supplemetal levels affecting positively the average daily gain of the animals, in order of the 0.132 kg/animal/day. The supplement efficiency (kg of supplement as fed/kg of ADG), obtained by a reciprocal of the coefficients of the linear regressions, were 7.6:1. The pasture intake (IP) were linearly reduced by the crescent supplemental levels (IP = 4.87 - 3.10x, r^2 = 0.84), by the way the total dry matter intake didn't not influenced by the concentrated levels, with a medium value of 4.8 kg/animal/day. The high cost of concentrate feeds compared to the pasture and the low efficiency of the concentrated conversion in weight gain even under tropical pastures can explain the use of concentrate by Brazilian farmers, which can have a greater probability for a low cattle performance.

Key Words: Cattle, Concentrate Conversion, Growth Rate

W269 Energy levels in multiple supplements for finishing beef cattle grazing *Brachiaria brizantha* pasture during the rainy to dry transition season. M. F. L. Sales, M. F. Paulino, P. V. R. Paulino*, M. O. Porto, and S. de Campos Valadares Filho, *Universidade Federal de Viçosa*, *Viçosa, MG, Brazil*.

The effects of increasing energy levels in multiple supplements for finishing beef cattle grazing *Brachiaria brizantha* cv. Marandu on performance and nutritional parameters were evaluated, during the rainy to dry transition season of the year 2004. For the performance trial, twenty four crossbred bulls, 18 month old and 330 kg of initial body weight (BW), were used, being distributed, randomly, into four paddocks of 1.5 ha each. Four treatments were evaluated: mineral salt (MS) and corn and whole soybean based supplements offered in 3 increasing allowance levels: 1.0; 1.5 and 2.0 kg/head/d, allowing TDN intake of, respectively, 0.832; 1.163 and 1.496 kg/head/d. There was detected a positive linear effect of the energy levels in the supplements on the average daily gain and on the final body weight (P<0.10). The nutritional parameters were assessed in a concomitant trial, in which four crossbred steers, 300 kg BW, fitted with esophageal, ruminal and abomasal cannula, and fed similar diets of those of the performance trial were used. There was not observed any effect of supplementation (P>0.05) on dry matter intake (DMI), although it was detected a linear reduction in forage intake (P<0.05) as the supplementation allowance increased. The organic matter intake of the pasture and the NDF intake of the total diet and of the pasture decreased linearly (P<0.05) as the energy level of the supplementation increased. There were no effects (P>0.05) of supplementation levels on the apparent digestibilities of any nutrients, except for crude protein (CP), which showed a quadratic response (P<0.05) to increasing level of supplementation. Additional weight gain, ranging from 20 to 30%, can be obtained in beef cattle supplemented with increasing amounts of energy during the period herein analyzed. However, those gains are due to substitution of supplement for forage.

Key Words: Beef Cattle, Supplementation, Pasture

W270 Effect of two buffers on nutrient digestibilities and rumina fermentation in Holstein steers. O. D. Montañez-Valdez*[1], E. O. Garcia-Flores[2], J. R. Barcena-Gama[3], S. S. Gonzalez- Muñoz[3], M. E. Ortega-Cerrilla[3], J. G. Peralta-Ortiz[3], and J. H. Avellaneda-Cevallos[4], [1]*Centro Universitario del Sur de la Universidad de Guadalajara*, *Ciudad Guzmán, Jalisco, México*, [2]*Centro Universitario del la Costa Sur de la Universidad de Guadalajara*, *Autlán, Jalisco, México*, [3]*Colegio de Postgraduados*, *Montecillos, Estado de México, México*, [4]*Universidad Técnica Estatal de Quevedo*, *Quevedo, Los Ríos, Ecuador*.

The effect of sodium bicarbonate (SB) and a commercial buffer (Acid Buf® AB; *Lithothamnium calcareum*; Celticsea Minerales. Srano Farm, Currabinny, Carrigaline, Co. Cork, Irlanda) on the *in situ* digestibility of DM, NDF and ruminal fermentation was evaluated. Five Holstein steers (BW 450±15 kg) fitted with rumen cannula were randomly assigned to a 5 × 5 latin square and housed in individual pens. Each period was 15 d, 10 d for adaptation to diets and 5 d for samples collection. Diet had 70% concentrate (47% ground sorghum, 8% soybean meal, 7% molasses cane, 6.8% corn gluten meal and 1.2% mineral premix) and 30 % forage (15% alfalfa hay and 15% corn silage) with addition of SB or AB. The treatments were: T1) control; T2) 1% SB; T3) 0.35% AB; T4) 0.50% AB; T5) 0.65% AB. There were no differences (P> 0.05) among treatments on *in situ* digestibility of DM, NDF or cellulolityc bacteria concentration. The ruminal pH was different among treatments (P≤ 0.05), the highest pH values were for T3 (6.35), as compared with T1 (5.98) and T2 (6.14). The rumen protozoa concentration was increased by AB (P≤ 0.05) in T3 ($7.71x10^6$) as compared with SB treatment (5.26×10^6) and control treatment (5.06×10^6). The use of these buffers on concentrate diets did not affect the *in situ* digestibility of MS and NDF, but improved ruminal pH and enhanced the rumen protozoa development.

Key Words: *In Situ* Digestibility, Diets, Buffers

W271 Phase feeding strategies to meet metabolizable amino acid requirements of calf-fed Holstein steers. R. A. Zinn[1], J. F. Calderón[2], L. Corona[3], A. Plascencia[2], M. F. Montaño[2], and N. Torrentera*[2], [1]*University of California, Davis*, *El Centro*, [2]*Universidad Autonoma de Baja California*, *Mexicali, B.C. Mexico*, [3]*Universidad Autonoma de Mexico*, *Mexico, D.F.*

One hundred eight Holstein steer calves (114 kg) were used to evaluate effects of phase feeding metabolizable amino acids (**MAA**) on growth performance and carcass characteristics. Three feeding strategies were evaluated: 1) control, single phase feeding (single urea-based growing finishing diet that meets MAA requirements for the overall feeding period); 2) two-phase feeding (diet formulated to meet the average MAA requirements for the first 112 d on feed, and thereafter, finished on the control urea-based diet) and 3) three-phase feeding (two diets during the first and second 56-d feedlot feeding periods, and thereafter cattle were finished on the urea-based diet). Growth performances among different phases were not different (P > 0.20). Multiple-phase feeding increased ADG (18%, P< 0.01), DMI (4%, P<0.05) and observed/expected dietary NE (16%, P<0.01) during the first 112 d of the study. From d 112 to slaughter there were no treatment effects (P > 0.20) on growth performance. However, multiple-phase feeding increased overall (351-d) ADG (6.3%, P < 0.01), DMI (3.7%, P < 0.10), gain efficiency (2.8%, P < 0.01), and observed/expected dietary NE (3.4%, P < 0.01). Multiple phase-feeding increased hot carcass weight (5.2%, P < 0.01), dressing percentage (1.0%, P < 0.10), fat thickness (25%, P < 0.05) and longissimus muscle (LM) area (8.8%, P < 0.05). Thus, observed dietary NEg was similar (96%) to expected for the two- and three-phase programs during the first 112 d, while it was only 83% of expected for the single-phase program. It is concluded that a two-phase feeding program, where diets for calf-fed

Holstein steers are formulated to meet the average MAA requirements for optimal growth rate, until 280 kg live weight, and from 280 kg until slaughter will enhance overall ADG, gain efficiency, and energetic efficiency compared with a conventional single-phase feeding program. Methionine, lysine and histidine appear to be the first limiting amino acids during the first feeding phase. During the second phase (280 kg to slaughter), supply of all MAA acids will exceed requirements, even where urea is the sole source of supplemental N.

Key Words: Amino Acid, Holstein Steer, Phase Feeding

W272 Relationships between feed efficiency, carcass and ultrasound traits in Angus beef cattle divergently selected for serum IGF–I concentration. F. R. B. Ribeiro*[1], G. E. Carstens[1], P. A. Lancaster[1], L. O. Tedeschi[1], and M. E. Davis[2], [1]*Texas A&M University*, *College Station*, [2]*The Ohio State University*, *Columbus*.

Objectives of this study were to characterize feed efficiency traits and examine phenotypic correlations with carcass and ultrasound traits in Angus bulls and heifers divergently selected for serum IGF–I concentration. Individual DMI were measured in Angus bulls (n = 27) and heifers (n = 29) fed a corn-based diet (ME = 2.85 Mcal/kg) for 70 d using Calan gates. Body weight was measured at 14–d intervals. Ultrasound back fat (**UBF**) and *longissimus* muscle area (**ULMA**) were measured on start and end of test. Cattle were harvested at the end of the test and carcass longissimus muscle area (**CLMA**) and back fat (**CFT**) were collected. Residual feed intake (**RFI**) was computed as the residuals from the linear regression of DMI on mid-test $BW^{0.75}$ and ADG with gender and interactions in the model. Overall mean (± SD) ADG, DMI and RFI were 1.78 ± 0.26, 10.47 ± 1.22, and 0.0 ± 0.70 kg/d for bulls and 1.30 ± 0.15, 9.43 ± 1.14, and 0.0 ± 0.64 kg/d for heifers, respectively. There were no significant differences in ADG, DMI, BW or feed efficiency traits between low and high IGF–I lines. Calves selected for low IGF–I had less (P<0.05) UBF, but similar ULMA at the end of the test than high IGF–I calves. As expected, heifers consumed less feed, grew slower, had a greater feed conversion ratio (**FCR**), and were fatter than bulls. Residual feed intake was correlated with DMI (0.57), and FCR (0.53) but not ADG. Initial BW (0.50) and UBF (0.29) were correlated with FCR, but not RFI, suggesting that calves with lower FCR were lighter and leaner at the start of the test. Final UBF and ULMA were not correlated with RFI or FCR, however carcass marbling score (0.44) was correlated to FCR. These results suggest that RFI was less influenced by rate and composition of growth, and BW compared to FCR. Divergent selection for serum IGF–I had no effect on performance or feed efficiency in Angus calves.

Key Words: Ultrasound, Residual Feed Intake, Feed Conversion Ratio

W273 Feed efficiency of beef cows and its progeny during the preweaning interval[1]. T. Z. Albertini[2], S. R. de Medeiros[3], R. A. de A. Torres, Jr.[3], A. R. D. L. Sousa[3], F. A. Biberg[3], and D. P. D. Lanna*[2], [1]*Fapesp, Embrapa*, [2]*ESALQ-USP*, *Piracicaba, SP, Brazil*, [3]*Embrapa Beef Cattle*, *Campo Grande, MS, Brazil*.

In this experiment the feed efficiency of non-pregnant lactating beef cows and their progeny was determined. Cow/calf pairs were individually fed from just after birth (17±5 d SD) to weaning at 211 d. Adult cows evaluated were 10 Caracu × Nelore and 10 Angus × Nelore that were bred to Red Angus and Canchim (5/8 Charolais) bulls, respectively. The diet (2.30±0.04 Mcal ME/kg and 12.4±0.9% CP) was fed in variable amounts and adjusted every 28 d in order to maintain weight and body scores. The same diet was offered *ad libitum* to the calves. Milk production was determined by milking each cow at 47, 75, 104, 132, 160, 188 and 216 d postpartum. Correlations among efficiency indexes were evaluated using MANOVA option of Proc GLM in SAS. The model included the effects: time at start of feeding period, genetic group, sex and age of calf at beginning of the experiment. Metabolizable energy intake (MEI) means for the progeny, derived from milk and from the solid diet, were 1504.3 (± 170.5 SD; 11.3% CV) and 595.0 Mcal (± 121.8 SD; 20.5% CV), respectively. Efficiency of calves was 85.1 g LWG_{210d}/Mcal of total MEI (milk+solid diet; ± 6.8 SD; 8.0% CV). Efficiency of cow/calf pairs was 34.9 g LWG_{210d}/Mcal MEI (± 4.3 SD; 12.3% CV) using total cow and calf solid diet intake. Phenotypical correlations showed association between the efficiency of calves and MEI from milk (r=-0.73; P<0.01) and between progeny efficiency and total MEI (intake of milk+solid diet; r=-0.74; P<0.01). Moreover, there was correlation (y = -0.0548x + 60.95) between the live weight of cows and the efficiency of cow/calf (r=-0.69; P<0.01). There was correlation between ME for maintenance (Mcal ME/$BW^{0.75}$) and BW of cows (r=0.58; P<0.05). In conclusion, heavier cows were associated with greater maintenance requirements and lower cow/calf pair efficiencies. It was also demonstrated a negative association between calf milk consumption and calf efficiency.

Key Words: Growth, Bioenergetics, Milk

W274 Body composition and net protein and energy requirements of steers from four zebu and zebu × B. taurus crossbreds[1]. R. Silva Goulart[2], E. Benno Pott[3], M. Mello de Alencar[3], G. Maria da Cruz[3], R. Tullio[3], and D. Pazzanese Duarte Lanna*[2], [1]*FAPESP, USP, Embrapa*, [2]*ESALQ/USP*, *Piracicaba, SP, Brazil*, [3]*Embrapa*, *Sao Carlos, SP, Brazil*.

The objective of this study was to determine body composition and net protein and energy requirements of four genetic groups: purebred Nelore (NE) and Aberdeen Angus × Nelore (AN), Canchim (5/8 Charolais) × Nelore (CN) and Simmental × Nelore (SN) crossbreds. Forty seven steers, 22 mo of age and 310 kg of BW, were evaluated in a completely randomized design. The comparative slaughter method was used with 16 animals slaughtered for baseline. EB composition was estimated from the 9-11th rib cut composition using specific equations developed for each genetic group. Diet was based on corn silage, corn and soybean meal, with 13.3% CP and 68.7% TDN, and was fed for a 101-d period. Data were analyzed by proc GLM of SAS, with effects of genetic groups. Results are presented in Table. There was no difference (P>0.05) between AN (428±9 kg) and SN (410±12 kg) in final empty body weight; also weight of CN (389±10 kg), NE (390±11 kg), and SN (410±12 kg) were similar. Steers of AN and SN groups had a greater proportion of ether extract and a smaller percentage of water in the empty body at slaughter. Cattle from SN and AN groups presented greater protein requirements than CN and NE. Steers of the AN group had the highest requirements of net energy for gain. Aberdeen Angus x Nelore cattle needed more energy and more protein than purebred Nelore steers.

Table 1. Empty body composition of Nelore (NE) and crossbreds (Angus, AN; Canchim, CN; and Simmental, SN) steers

Variables	AN	CN	NE	SN	Standar Error
Composition					
Water (%)	56.8[b]	58.1[a]	58.3[a]	55.5[b]	.46
Ether extract (%)	22.6[a]	20.6[b]	20.4[b]	22.3[a]	.54
Protein (%)	16.6[c]	17.1[b]	^17.1[b]	17.8[a]	.07
Ash (%)	4.1[c]	4.2[b]	4.2[b]	4.4[a]	.01
Energy (Mcal/kg)	3.1[a]	2.9[b]	2.9[b]	3.1[a]	.04
Net requirements for gain					
Energy (Mcal/kg of EBW)	4.70[a]	4.45[bc]	4.08[c]	4.50[b]	.16
Protein (kg/kg of EBW)	0.14[a]	0,142[c]	0.153[b]	0,164[a]	.003

[abc] Means with different superscripts differ (P<.05)

Key Words: Body Composition, Nelore Crossbred, Tissue Deposition Rates

W275 Relationship between residual feed intake, water intake and ultrasound body composition traits in Angus bulls. G. R. Hansen*[1], G. E. Carstens[2], and D. G. Riley[3], [1]*University of Florida NFREC*, *Marianna*, [2]*Texas A & M University*, *College Station*, [3]*USDA-ARS STARS*, *Brooksville, Fl.*

The objective was to examine the relationship between residual feed intake (RFI), water intake (WI), feed conversion ratio (FCR), initial feed consumption (IFC—total intake for first 2 wk prior to 70-d trial) and real time ultrasound body composition traits (RTUS) in 9-mo-old Angus bulls (n=126). Bulls were produced using embryo transfer at a private farm and moved to a GrowSafe feeding facility in summer 2006. Individual daily feed intake (DMI), daily WI and BW (every 2 wk) were obtained during a 70-d feeding trial. RTUS were measured on d 70. RFI was calculated by regressing dry matter intake on ADG and mid-test $BW^{.75}$. Bulls were assigned to high (bull RFI > mean + 0.5 SD), medium (bull RFI between mean ± ? 0.5 SD) and low (bull RFI < mean – 0.5 SD) RFI groups. ADG, DMI and RFI were 1.54 ± 0.28 kg/d, 10.63 ± 1.73 kg/d and 0.00 ± 1.39, respectively. Low, medium and high RFI groups differed (P<0.05) for IFC. Low RFI bulls consumed 19.9 % less feed (P<0.001) and 32.4 % less water (P<0.001) than high RFI bulls. There were no differences for ADG, % IMF, or ribeye area among RFI groups. Beginning scrotal circumference (d -14) was greater (P<0.05) in high RFI bulls than low or medium groups. Residuals were generated for traits by adjusting for pen, age, sire and dam effects. Residual correlations were calculated using residual values. FCR was associated with RFI using simple (0.61) and residual (0.40) correlations.

Table 1. Correlations among traits for Angus bulls

	RFI	WI	Ribfat	DMI	IFC
RFI	--	0.43	0.44	0.73	0.59
WI	0.33	--	0.23	0.40	0.23
Ribfat	0.33	0.29	--	0.33	0.38
DMI	0.52	0.40	0.27	--	0.71
IFC	0.38	0.24	0.37	0.58	--

Simple correlations above diagonal and residual correlations below diagonal

Key Words: Feed Efficiency, Residual Feed Intake, Carcass Traits

W276 Effect of yeast culture on 28-day performance of newly weaned, low-stress beef calves. C. R. Belknap*[1], R. R. Scott[2], and J. C. Forcherio[2], [1]*Diamond V Mills*, *Cedar Rapids, IA*, [2]*LongView Animal Nutrition Center*, *Gray Summit, MO*.

The objective of this study was to determine the effect of yeast culture (Diamond V XPC™ Yeast Culture, Diamond V Mills) on 28-d post-weaning performance when fed to ranch-weaned calves that had previously received creep feed for 111 d. Seventy-four Angus x Charolais calves were removed from their dams, weighed, vaccinated and held in dry lot overnight with access to hay and water. The next morning, calves were reweighed and assigned to one of five weight blocks. Within weight blocks, calves were equally distributed to one of two treatment pens based on sex and age of dam. Treatments consisted of: Control (C) or 0.25% Diamond V XPC Yeast Culture (YC). The basal diet consisted of a coarse textured complete feed (88% DM) containing cracked corn, cottonseed hulls and supplemental pellet. Both treatments contained chlortetracycline and sulfamethazine (Aureo S-700®, Alpharma Animal Health) at 77 g/ton and 0.0084% respectively. Yeast culture was provided in the supplemental pellet for the YC treatment. Calves were fed twice daily and brought up on feed the initial 5 d, then allowed to consume feed ad libitum. DMI was recorded daily. Initial and final weights (28 d) were averaged from two consecutive weights. After the 5-d step-up period, calves fed YC had numerically higher DMI the remaining days on trial (data not shown) and DMI tended to be increased (P<0.19) compared to C (Table 1). Final BW and ADG were increased (P<0.01) by the addition of YC to the weaning diet. These data indicate that Diamond V XPC Yeast Culture will increase ADG of low-stress, ranch-weaned calves when fed in conjunction with chlortetracycline and sulfamethazine.

Table 1. Effect of yeast culture on 28-d post-weaning performance.

	Control	Yeast Culture	P <
Initial BW, kg	270	270	NS
Final BW, kg	319	323	0.01
DMI, kg/d	6.70	7.07	0.19
ADG, kg/d	1.67	1.81	0.01
F/G, kg/kg	4.00	3.91	NS

Key Words: Beef Cattle, Yeast Culture, ChlortetraCycline

W277 Effects of an intratracheal challenge with *Mannheimia haemolytica* on intake and N balance in fed or fasted steers. L. O. Burciaga-Robles*[1], C. R. Krehbiel[1], D. L. Step[2], B. P. Holland[1], M. Montelongo[2], A. W. Confer[2], J. N. Gilliam[2], and C. L. Goad[3], [1]*Department of Animal Science*, [2]*Center for Veterinary Health Sciences*, [3]*Department of Statistics. Oklahoma State University*, *Stillwater*.

The objective was to determine acute (5 d) and longer-term (2 wk) effects of an intratracheal challenge with *Mannheimia haemolytica* on DMI and N balance in fed or fasted steers. Twenty-two steers (BW = 320±24 kg) were assigned to one of four treatments: 1) fed ad libitum and not challenged (FED/CON); 2) fed ad libitum and challenged (d 0) with *M. haemolytica* (FED/CH); 3) fasted for 72 h and not challenged (FAST/CON); or 4) fasted for 72 h and challenged (d 0) with *M. haemolytica* (FAST/CH). Feed, total urine and feces were collected for three (d -3, -2, and -1), five (acute response on d 0, 1, 2, 3, and 4;

wk 1), three (d 6, 7, and 8; wk 2), and three (d 14, 15, and 16; wk 3) days. Challenge with *M. haemolytica* increased (P < 0.05) antibody concentration of the whole bacteria on day 15. In the acute model, DMI responded with a diet*challenge*day interaction (P = 0.02). After the 72 h fast, FAST/CON steers consumed a similar amount of DM as FED/CON. Steers challenged with *M. haemolytica* had lower (P < 0.05) DMI during the first 2 (FED) and 4 (FAST) d. In the long-term model a diet*challenge*week interaction was observed (P = 0.002). FED/CON steers generally had constant DMI in comparison with FAST/CON and FED/CH. No difference was observed (P > 0.10) in DMI among FED/CON, FAST/CON, and FED/CH during wk 2 and 3 of the experiment. FAST/CH steers had lower (P < 0.05) N retention than FED/CON steers 4 d after the challenge (diet*challenge*day interaction, P = 0.09). Nitrogen retention of FAST steers was lower (P = 0.006) compared with FED steers. Steers challenged with *M. haemolytica* tended (P = 0.10) to retain less N during the acute response. For the longer-term model no statistical difference was observed (P = 0.20) for N balance. Our data suggest that cattle that are fasted and challenged with a bovine respiratory pathogen retain less N for up to 4 d following the insult.

Key Words: Diet, *M. haemolytica*, N Balance

W278 Feedlot performance and rumen parakeratosis incidence in *Bos indicus* type bullocks fed high-grain diets and monensin or polyclonal antibody preparations against rumen bacteria. D. D. Millen*, R. D. L. Pacheco, M. D. B. Arrigoni, M. Parrili, S. A. Matsuhara, M. V. Fossa, L. M. N. Sarti, C. L. Martins, J. P. S. T. Bastos, and T. M. Mariani, *FMVZ/UNESP–Botucatu*, *São Paulo, Brazil*.

Oral dosing of polyclonal antibody preparations (PAP) against *Streptococcus bovis* or *Fusobacterium necrophorum* enhanced feedlot performance of *Bos taurus* cattle. This study, conducted at the São Paulo State University feedlot, Botucatu Campus, Brazil, was designed to test PAP against *S. bovis*, *F. necrophorum*, and several strains of proteolytic bacteria (RMT) on performance and parakeratosis incidence of *Bos indicus*-based types. The experiment was designed as a 3 X 2 factorial, replicated thrice (4 bullocks/pen), in which 24 9-mo-old bullocks (297 kg) of each of three *Bos indicus*-based types: 3-way cross (1/2 Brangus, 1/4 Angus, 1/4 Nellore; TC), Canchim (5/8 Charolais, 3/8 Nellore; CC), or Nellore (NE) were fed one of two diets containing either monensin (MO) at 300 mg/d or RMT at 10 mL/d. Bullocks were fed ad libitum twice daily and, at harvest, rumen parakeratosis was scored on the entire washed rumen using a scale of 0 (no lesions noted) to 10 (severe ulcerative parakeratosis). Diets contained 50% high moisture corn, 21% cracked corn, 10% soybean meal, 10% sugarcane bagasse, 5% corn silage and 4% supplement (DM basis). There were no interactions (P > 0.05) between breed type and feed additive. Bullocks fed RMT had similar (P > 0.05) ADG (1.34 vs. 1.30 kg), DMI (8.28 vs. 8.02 kg/d) and DM required/kg gain (6.17 vs. 6.17 kg) as those fed MO. When analyzed as percentage of BW, bullocks fed RMT consumed (P< 0.05) more feed than those fed MO (2.20 vs. 2.14%). Bullocks fed RMT tended (P = 0.09) to have lesser rumen parakeratosis scores than those fed MO (55.6% vs. 45.7% of the rumens from bullocks fed RMT and MO scored between 0 and 1, respectively). Crossbred cattle (TC and CC) had greater (P < 0.05) DMI and ADG, and better (P < 0.05) feed conversion than purebred NE. Rumens from NE bullocks had greater (P < 0.05) parakeratosis scores than those of crossbreds. Feeding RMT enhanced intake of *Bos indicus*-based bullocks fed high-grain diets while maintaining rumen health, and permitting performance similar to that of bullocks fed monensin.

Key Words: PAP, Monensin, Performance

W279 Effects of a saccharin-containing additive (SUCRAM) on total tract digestibility, plasma metabolites, and urine organic acid excretion by steer calves. C. H. Ponce*[1], M. S. Brown[1], J. C. Silva[1], P. Schlegel[2], and W. Rounds[3], [1]*West Texas A&M University*, *Canyon*, [2]*Pancosma, SA*, *Geneva, Switzerland*, [3]*Prince Agri Products*, *Quincy, IL*.

Previous data suggest that SUCRAM C-150 (97% sodium saccharin; Pancosma SA) may improve growth performance by stressed beef calves. Fifteen steers (261 +/- 28 kg BW) were used to evaluate the effects of SUCRAM C-150 on total tract digestibility, plasma metabolite concentrations, and urine monoamine metabolite concentrations. Treatments included ad libitum access to a 60% concentrate diet (NC), ad libitum access to NC + 180 g of SUCRAM C-150/ton of DM (AS), and NC + 180 g of SUCRAM C-150/ton of DM with feed intake paired to NC (PS). Steers were adapted to treatments for 28 d before a 5-d collection of total feces and urine excreted. Jugular blood samples were collected on the last day of collection period. Steer DMI during the metabolism period did not differ (P > 0.15) between PS and NC (93 and 97 +/- 4 g/kg of $BW^{0.75}$, respectively), but DMI tended (P = 0.14) to be greater for AS (105 g/kg of $BW^{0.75}$) than for NC. Treatments did not alter (P > 0.15) apparent total tract DM, OM, CP, or NDF digestibility. Plasma homocysteine concentration was reduced (P < 0.03) by feeding PS or AS (0.57, 0.39, and 0.44 +/- 0.04 ug/mL for NC, PS, and AS, respectively). No differences were detected (P > 0.15) in plasma concentrations of tryptophan, large neutral amino acids, branched chain amino acids, or in the ratio of tryptophan to either large neutral or branched-chain amino acids. Urinary concentration (mmol/mol creatinine) of ethylmalonic acid, vanillymandelic acid (0.68, 1.65, and 1.47 +/- 0.23 for NC, PS, and AS, respectively), and 5-hydroxyindolacetic acid were greater (P < 0.06) for steers receiving AS than for steers receiving NC; steers fed PS had a greater (P = 0.02) urine vanillymandelic acid concentration than steers fed NC and tended (P < 0.12) to have a greater urinary concentration of ethylmalonic and 5-hydroxyindolacetic acid. The volume and mass of urine excreted did not differ (P > 0.32). Data suggest that saccharin-specific alterations in metabolism by calves may include reduced plasma homocysteine and increased excretion of vanillymandelic acid.

Key Words: Saccharin, Sweetener, Monoamine Metabolites

W280 Evaluation of feeding behavior of young cattle from different genetic groups fed with high concentrate diets with different NDF levels. L. M. N. Sarti, R. D. L. Pacheco*, D. D. Millen, M. D. B. Arrigoni, M. V. Fossa, S. A. Matsuhara, M. Parrili, C. L. Martins, H. N. Oliveira, T. M. Mariani, J. P. S. T. Bastos, and L. F. S. Niero, *FMVZ/UNESP–Botucatu*, *São Paulo, Brazil*.

The objective was to evaluate the feeding behavior of young cattle from different genetic groups (GG) with different zebu percentage in their compositions fed high concentrate diets with different NDF levels. The study had 3 GG (3 way cross – 1/2 Braunvieh, 1/4 Angus,

1/4 Nellore (TC); Canchim – 5/8 Charolais, 3/8 Nellore (CC) and Nellore (NE)) evaluated with four different diets (DD) with varying concentrate and NDF levels (Concentrate (%) = 58, 73, 82 and 85; NDF (%) = 38.1, 30.9, 27.7 and 23.0; respectively). We evaluated grams per hour feeding efficiency of dry matter (FEDM) and NDF (FENDF) and rumination efficiency of dry matter (REDM) and NDF (RENDF). The experiment was conducted at the experimental feedlot of the Veterinary Medicine and Animal Science College, São Paulo State University, Botucatu campus (UNESP), Brazil. Twelve 8–month–old TC, CC and NE bulls (297±84 kilos) were fed from creep feeding for 135 d, with 4 animals per group tested. For FEDM (g/hour) we found an effect (P<0.05) for GG and DD (TC=4183.66^{b}, CC=3037.81^{a}, NE=2280.24^{a}; 1=2482.99^{c}, 2=2511.20^{c}, 3=3385.01^{d}, 4=4289.74^{d}) but there was no interaction among them. Regarding FENDF, REDM and RENDF, we found effects for GG, DD and an interaction. TC was more efficient (P<0.05) than NE and CC for FENDF in the diets tested (TC=1354.12, CC=954.33, NE=713.70). For REDM, the TC was better (P<0.05) when compared to NE, but the CC did not differ when compared to TC and NE in the four diets tested (TC=1668.54, CC=1378.20, NE=1149.80). For RENDF, the TC was more efficient (P<0.05) than NE, but the CC did not differ when compared to TC and NE for all diets evaluated (TC=526.58, CC=440.47, NE=366.08). In conclusion, the TC and NE were more and less efficient, respectively, regarding the feeding behavior efficiencies evaluated. As zebu percentage in the GG composition gets lower, the concentrate level of the diets could be increased and vice versa, showing a grain adaptation in animals with low zebu percentage in GG composition.

Key Words: Feeding Behavior, FDN, Efficiency

W281 Beet pulp as a non-roughage fiber source in a total concentrate diet fed growing heifers. A. D. Faleiro, A. Ferret*, X. Manteca, J. L. R. de la Torre, and S. Calsamiglia, *Universitat Autonoma de Barcelona*, *Bellaterra, Spain*.

Eight rumen fistulated Holstein heifers (140 ± 24 kg, initial BW) were used to study the effect of using beet pulp as a non-roughage fiber source in a high concentrate diet. The variables studied were intake, ruminal fermentation and growth. All heifers were fed *ad-libitum* a concentrate composed of (DM basis) barley (31.4%), corn (32.2%), soybean meal (8%), corn gluten feed (9%), beet pulp (16%), and a mineral and vitamin compound (3.4%). The chemical composition of the concentrate was: 2.9 Mcal/kg ME, 14.9% CP, 24.2% NDF, 11.4% ADF, on DM basis. Four animals received barley straw as a roughage supplement (Diet A), while the other 4 did not (Diet B). The experiment was performed in six 28-d periods, and sampling was carried out in the last week of each period. Intake was recorded during five consecutive days. Feed and refusal samples were taken to determine DM, CP and NDF content. Ruminal samples were collected over 3 d at 0, 4, 8, and 12 hours post-feeding to measure pH, and VFA and NH3-N concentrations. Body weight was recorded on 1 d of each period. Data were analyzed using the generalized mixed model adequate for repeated measures. The model contained the effect of diet, period, and their interaction as fixed effects. Period was used as a repeated factor, and animal as a random effect. Barley straw intake in heifers fed diet A was 0.5kg/d. There were no statistical differences in concentrate DM intake (6.8 ± 0.42 kg/d) or CP intake (1.1 ± 0.07 kg/d). In contrast, there were statistical differences (P < 0.001) in ADF intake (kg, Diet A = 0.852, Diet B = 0.582), ruminal pH (Diet A = 6.0, Diet B = 5.5), total VFA (mM, Diet A = 134.3, Diet B = 153.4), propionate proportion (mol/100 mol, Diet A = 21.7, Diet B = 33.4), and acetate to propionate ratio (Diet A = 2.6, Diet B = 1.4). The ruminal concentration of NH3-N was not different (5.2 ± 0.84 mg/100 mL). Diets had no effect on ADG, (1.3 ± 0.06 kg/d). Results indicate that beet pulp as a non-roughage fiber source affected ruminal fermentation but did not change performance in a feedlot compared to a high-concentrate diet supplemented with barley straw.

Key Words: Beet Pulp, Concentrate Diet, Growing Heifers

W282 Post weaning performance of Holstein dairy heifers fed diets differing in forage quality and supplemented with a low moisture block. H. Chester-Jones*[1], D. Ziegler[1], R. Larson[2], B. Ziegler[2], J. Linn[3], M. Raeth-Knight[3], and G. Golombeski[3], [1]*University of Minnesota Southern Research and Outreach Center*, *Waseca*, [2]*Hubbard Feeds*, *Mankato, MN*, [3]*University of Minnesota Southern Research and Outreach Center*, *St. Paul*.

Ninety-six dairy heifers were used in a 112-d study to evaluate feed intake and performance from 9 to 25 weeks of-age. Heifers (92.3 ± 0.93 kg BW) were randomly assigned to 1 of 4 grower diets (6 heifers/pen, 4 pens/treatment). Heifers were each fed a cracked corn and pellet grain mix (16%CP) limit-fed to 2.72 kg/d (as fed) from d 1 to 14 and to 1.82 kg/d from d 15 to 112 with free choice hay. Treatments were: 1) LOW: alfalfa hay (19.3% CP; 100 RFV); 2) LOWB: alfalfa hay and low moisture molasses-based block (30% CP); 3) MED: alfalfa hay (19.6 % CP; 130 RFV); and 4)HIGH: alfalfa hay (18.6 % CP; 154 RFV). Using the low moisture block increased ADG by 4.0% and feed efficiency (FE) by 2.3% for the LOWB as compared to the LOW treatment. Feeding a higher quality hay increased ADG by 9.0% and FE by 3.0% for the MED compared to the LOW and LOWB treatments. Heifers receiving the highest quality hay (HIGH) had increased ADG (1.4%) and FE (5.9%) compared to heifers fed the MED treatment. Final BW for heifers fed LOW (188.9 kg) and LOWB (193.1 kg) were lower (P < 0.05) than heifers fed MED (198.9 kg) and HIGH (202.0 kg), respectively. Over the 112 d study, ADG (kg/d), grain DMI (kg), hay DMI (kg/d) and FE (kg feed/kg gain) were 0.87, 1.70, 2.41, 4.78; 0.91, 1.70, 2.36, 4.62; 0.96, 1.70, 2.68, 4.59; 0.97, 1.70, 2.49 and 4.33 kg for heifers fed LOW, LOWB, MED, and HIGH treatments, respectively. Under the conditions of the study, performance of all heifers was acceptable and an economic comparison should be the criteria to select the hay of choice when limit feeding grain mixes. The study demonstrated that feeding up to 2.72 kg daily of a 16% CP grain mix for the first 14 d followed by 1.82 kg/d from d 15 to 112 with access to FC alfalfa hay provides sufficient energy and protein for acceptable heifer growth.

Key Words: Dairy Heifers, Grain Mixes and Forage Quality, Performance

W283 Performance of Holstein dairy heifers fed whole-shelled corn and protein pellet diets differing in protein levels. D. Ziegler*[1], M. Raeth-Knight[2], J. Linn[2], G. Golombeski[2], R. Larson[3], B. Ziegler[3], and H. Chester-Jones[1], [1]*University of Minnesota Southern Research and Outreach Center*, *Waseca*, [2]*University of Minnesota*, *St. Paul*, [3]*Hubbard Feeds*, *Mankato, MN*.

Ninety-six dairy heifers (93.8 ± 0.77 kg BW) were used in a 112-d study to evaluate feed intake and performance from 9 to 25 weeks of age when offered limit (LF) or full-fed (FF) whole-shelled corn and pellet (WCP) diets varying in protein level, with or without access to free choice (FC) hay. Heifers were randomly assigned to 1 of 4 grower diets (6 heifers/pen, 4 pens/treatment). Treatments from d 1 to 56 were 1) 16LF: 16% CP WCP, LF to 2.72 kg/calf (as-fed) and FC alfalfa hay (19.7% CP, DM basis); 2) 13FF: 13% CP WCP, FF with no hay; 3) 16FF: 16% CP WCP, FF with no hay; and 4) 19FF: 19% CP WCP, FF with no hay. Day 57 to 112 all heifers were LF their respective WCP up to 2.27 kg daily with FC hay. Day 1 to 56, heifers fed 16LF had the lowest (P <0.05) daily gain (1.01 kg/d) and highest feed/gain (3.64) vs. FF diets, which averaged 1.25 kg/d and 3.13 kg feed/kg BW gain, respectively. From d 57 to 112, heifers fed 16LF had 10.2% higher (P <0.05) ADG (1.08 kg/d) compared to the 13FF, 16FF and 19FF diets which averaged 0.97 kg/d. Total gain over 112-d for 16LF heifers (116.6 kg) was 6.2% lower than the other treatments which averaged 124.4 kg. Daily gain (kg/d) and feed/gain for the 112-d study were 1.04, 4.42; 1.10, 4.29; 1.11, 4.11; 1.13, and 4.03 kg for 16LF, 13FF, 16FF, and 19FF heifer groups, respectively. Initial hip heights (HH) averaged 105.3 cm with similar (P > 0.05) HH gains (20.8 cm) for all heifer groups over the 112-d. Body condition score gain for 16LF heifers was +0.77 being 9.4% less than the other heifer groups (+0.85). Under the conditions of this study, all treatments resulted in adequate heifer growth. The results will allow for further refinement of protein levels to use in grain mixes.

Key Words: Dairy Heifers, Concentrate Protein Levels, Performance

W284 Effects of amount and composition of concentrate on silage and total DM intake of dairy cows. P. Huhtanen*[1], M. Rinne[2], and J. Nousiainen[3], [1]*Cornell University*, *Ithaca, NY*, [2]*MTT-Agrifood Research*, *Finland*, [3]*Valio Ltd*, *Finland*.

Dry matter intake (DMI) explains most of the variation in nutrient supply and milk production. DMI is regulated by animal, diet and management factors and their complex interactions. Our objective was to develop a DMI model describing the relative intake potential of the diet. A data set of 960 diets from 204 production trials with dairy cows was collected. The effects of concentrate feeding on silage DMI were investigated in 168 comparisons including 610 diets. The data was further divided into sub-sets: level of concentrate, and CP, NDF and fat concentration of concentrate. Within each comparison the same forage was fed ad libitum. A mixed model regression analysis was used to estimate the relationships between silage DMI (SDMI) and independent variables. SDMI decreased quadratically with increased concentrate DMI (CDMI). The substitution rate increased with increasing relative SDMI potential. An increase in concentrate CP concentration in response to replacement of energy substrates with protein feeds (e.g. soybean or rapeseed meal) was associated with quadratic increases in silage and total DMI. Replacement of starchy ingredients with fibrous by-products in concentrate slightly increased DMI, whereas fat supplementation had a negative effect on DMI. The effects of different components (CDMI, CP, NDF and fat concentration and interaction CDMI Ã— SDMI potential) were combined to create a relative CDMI index. Relative CDMI index predicted the intake responses within a study precisely as indicated by a low mean squared prediction error (MSPE = 0.33 kg) between predicted and observed DMI adjusted for random study effect. The total DMI (TDMI) index calculated as CDMI + SDMI indexes predicted TDMI within a study precisely (MSPE = 0.37 kg, n = 960). One TDMI index point corresponded to a 0.103 kg DMI, i.e. very close to the default value of 0.10. Marginal responses in TDMI of grass silage based diets to changes in diet composition can be predicted accurately and precisely, but predicting absolute intakes needs a better characterization of the animal's intake potential.

Key Words: Intake Prediction, Grass Silage, Modelling

W285 Please see abstract # 278.

W286 Effects of feeding monensin and brown midrib corn silage on milk production and rumen fermentation. C. R. Mullins*, A. M. Gehman, P. J. Kononoff, and B. N. Janicek, *University of Nebraska*, *Lincoln*.

An experiment was conducted to compare rations including brown midrib corn silage (*bm3*) and a control dual purpose hybrid (DP) on milk production and rumen fermentation. The effect of monensin in these rations was also examined. Twenty multiparous Holstein cows (4 ruminally cannulated) averaging 101 ± 34 DIM (mean ± SD) and 674 ± 77 kg BW were assigned to one of five 4 × 4 Latin squares, using a 2 X 2 factorial arrangement of treatments. Cows were fed one of four treatments during each of the four 28-d periods: 1) C-*bm3*, 0 mg/d monensin and *bm3*, 2) C-DP, 0 mg/d monensin and DP, 3) M-*bm3*, 300 mg/d monensin and *bm3*, and 4) M-DP, 300 mg/d monensin and DP. Diets were formulated to maintain energy, neutral detergent fiber, and non-fiber carbohydrate concentrations across treatments. Diets containing *bm3* contained more corn silage than those containing DP (54 vs. 49 % DM). *In vitro* 30 h neutral detergent fiber digestibility was higher for *bm3* than DP (61.0 vs. 49.1 ± 0.62 %). Monensin tended ($P = 0.07$) to increase rumen pH (5.89 vs. 5.79 ± 0.07) compared to the control treatment. In addition, diets containing *bm3* resulted in a decrease ($P < 0.01$) in rumen pH (5.72 vs. 5.98 ± 0.07). Monensin had no effect on molar concentration of acetate, propionate, or butyrate. In contrast, monensin increased ($P < 0.01$) branched chain volatile fatty acids. Diets containing DP resulted in a higher ($P < 0.01$) concentration of propionate (27.4 vs. 26.3 ± 1.77 mol/100 mol) and tended to have a higher ($P = 0.07$) acetate concentration (56.0 vs. 55.2 ± 1.30 % mol/100 mol). Cows consuming diets containing *bm3* tended ($P = 0.08$) to have higher dry matter intake (21.3 vs. 20.2 ± 0.63 kg/d) but was not affected by monensin. No differences were observed in 3.5% fat-corrected milk, averaging 38.0 ± 2.09 kg/d. In addition, no differences were observed for fat and protein yield, averaging 1.34 ± 0.08 and 1.13 ± 0.06 kg/d respectively. Monensin supplementation increased rumen pH, without affecting dry matter intake or milk production. Diets containing *bm3* were consumed in greater amounts but did not affect milk production or composition.

Key Words: Brown Midrib Corn Silage, Monensin, Dairy Cow

W287 Effects of mixing red clover silage with grass silage on the fatty acid and sensory properties of milk from dairy cows. J. M. Moorby*[1], D. R. Davies[1], W. J. Fisher[1], N. M. Ellis[1], N. D. Scollan[1], and G. R. Nute[2], [1]*Institute of Grassland and Environmental Research*, *Aberystwyth, UK*, [2]*University of Bristol*, *UK*.

Twenty-four multiparous mid-lactation Holstein-Friesian dairy cows were used in a replicated 4×4 Latin square changeover design experiment to test the effects of changing from ryegrass silage to red clover silage in graded proportions on milk fatty acid (FA) profiles and organoleptic qualities. Four diets were offered comprising ad libitum access to 1 of 4 forage mixes plus 4 kg dairy concentrates per d. The forage mixes were, on a DM basis: 1) 100% ryegrass silage (GS), 2) 66% GS:34% red clover silage (RCS), 3) 34% GS:66% RCS, and 4) 100% RCS. Each experimental period comprised 21 d for adaptation to diets and 7 d of measurements. Milk FA profiles were hardly affected by diet, with no significant effects on $C_{18:2}$ and $C_{18:3}$ FAs. Similarly, and perhaps because of this, there was little effect of diet on organoleptic qualities of pasteurised milk as assessed by taste panel analysis, with no effects on milk aroma, aftertaste, or overall liking. The appearance of milk was thicker ($P < 0.001$ linear effect) and more cream-coloured ($P < 0.001$ linear effect) when cows were fed GS compared to when fed RCS. The flavour of milk was largely unaffected by diet, apart from a quadratic ($P < 0.05$) effect of diet on the sour flavour characteristic, with milk from cows on the two extreme diets scoring higher than milk from cows on the two mixed silage diets, and a small but significant ($P = 0.010$) linear effect of treatment on the boiled milk flavour, with an increasing score as the proportion of RCS in the diet increased. In conclusion, increasing the proportion of RCS in the diet of dairy cows had little effect on milk FA profiles or on milk organoleptic characteristics.

Key Words: Red Clover Silage, Milk Fatty Acids, Taste Panel

W288 Effects of mixing red clover silage with grass silage on feed intake and milk output from dairy cows. J. M. Moorby*, D. R. Davies, W. J. Fisher, N. M. Ellis, and N. D. Scollan, *Institute of Grassland and Environmental Research*, *Aberystwyth, UK*.

Twenty-four multiparous mid-lactation Holstein-Friesian dairy cows were used in a replicated 4×4 Latin square changeover design experiment to test the effects of changing from ryegrass silage to red clover silage in graded proportions on feed intakes, milk production, and milk composition. Four diets were offered comprising ad libitum access to 1 of 4 forage mixes plus 4 kg dairy concentrates per d. The forage mixes were, on a DM basis: 1) 100% ryegrass silage (GS), 2) 66% GS:34% red clover silage (RCS), 3) 34% GS:66% RCS, and 4) 100% RCS. Each experimental period comprised 21 d for adaptation to diets and 7 d of measurements. Total dry matter intakes ($P < 0.001$) increased linearly as the proportion of RCS in the diet increased (16.7, 17.8, 18.3, 19.0 kg/d, SED = 0.024). Milk yields also increased with inclusion of RCS in the diet (25.2, 26.1, 26.5, 26.1 kg/d, SED = 0.47, $P < 0.05$ linear effect, $P < 0.05$ quadratic effect) but the increase was not as great as the DMI increase so that the efficiency of milk production (kg milk/kg DMI) decreased linearly ($P < 0.001$). Concentrations of milk fat and protein decreased linearly ($P < 0.001$) as the proportion of RCS in the diet increased, but yields of fat were unaffected. There was a significant ($P < 0.01$) quadratic effect on protein yield, with the highest yields from the two mixed diets. In conclusion, increasing the proportion of RCS in the diet of dairy cows increased feed intakes and milk yields, with the highest milk and milk protein yields from the 34% GS:66% RCS diet. However, including RCS in the diet decreased milk fat and protein concentrations and milk production efficiency.

Key Words: Red Clover Silage, Milk Production, Feed Intake

W289 Intake, digestibility and milk production and composition of dairy cows fed sugar–cane based diets corrected with soybean meal or different levels of urea. A. H. do Nascimento Rangel*[1], J. M. de Souza Campos[2], S. de Campos Valadares Filho[2], A. Barbosa[2], and P. V. R. Paulino[2], [1]*Universidade Federal Rural do Semi–Árido*, *Mossoró, RN, Brazil*, [2]*Universidade Federal de Viçosa*, *Viçosa, MG, Brazil*.

The mixture of sugar–cane and urea was been widely used by dairy cattle producers in Brazil, mainly during the dry season of the year. However, more research is needed in order to determine the most appropriate level of urea to be included in this kind of diet. Thus, the objective of this work was to evaluate the effect of sugar–cane based diets, corrected with soybean meal based concentrate (SM) or different levels of urea, on the intake, digestibility and milk production and composition of dairy cows. Twelve pure and crossbred Holstein cows were used, being arranged in three 4 × 4 Latin squares, distributed according to lactation period. The diets were formulated to be isonitrogenous, containing 14% crude protein on the dry matter (DM) basis. The daily supply of concentrate was fixed at 0.5 kg for each kg of milk produced. The urea levels tested were 0.4, 0.8 and 1.2%, on the natural matter basis. Following the analysis of variance, it was performed the decomposition of sums of squares for treatments into non–orthogonal contrasts, comparing the sugar cane diet corrected with SM based concentrate with the diets in which the different urea levels were used. Linear and quadratic effects of the three urea levels were also tested. There were no differences among the diets ($P > 0.05$) in the intakes of dry matter (DM), organic matter (OM), ether extract (EE), total carbohydrates (CHO), non–fiber carbohydrates (NFC) and neutral detergent fiber (NDF). A decreasing linear effect ($P<0.05$) was found for NDF intake among diets containing different urea levels. No effect of diet was observed ($P > 0.05$) for the apparent digestibility coefficients of DM, OM, CP, EE, NDF and NFC. A linear effect was detected ($P<0.05$) for the total carbohydrates digestibility and for the TDN content of the diet, which increased as the urea level increased. Milk production, corrected or not for 3.5% of fat, and milk composition did not differ ($P>0.05$) among the diets tested. The mean value of milk production, corrected for 3.5% of fat, was 20.07 kg/d. The diets containing urea were more profitable than the diet containing soybean meal, justifying its use by the producer in order to reduce feeding costs of the herd.

Key Words: Holstein, Sugar-Cane, Urea

W290 Performance and nutritional parameters of replacement dairy heifers fed corn silage or sugar–cane based diets supplemented with increasing concentrate levels. A. H. do Nascimento Rangel*[1], J. M. de Souza Campos[2], P. V. R. Paulino[2], A. J. de Assis[2], and A. S. de Oliveira[2], [1]*Universidade Federal Rural do Semi–Árido*, *Mossoró, RN, Brazil*, [2]*Universidade Federal de Viçosa*, *Viçosa, MG, Brazil*.

This study evaluated the response of replacement dairy heifers to a corn silage based diet, supplemented with 1.3 kg/day of concentrate, and to three sugar–cane based diets, corrected with 1% of the mixture urea and ammonium sulphate (9:1), and supplemented with 1.3; 2.0 and 2.7 kg/d of concentrate, respectively. Twenty animals were used (12 Holstein and 8 Brown Swiss heifers), with initial body weight (BW) of 176 kg. The experiment was arranged in a randomized block design, with 5 blocks, considering each animal as an experimental unit and the blocks formed on the basis of initial BW and breed. Dry matter

intake (DMI), organic matter (OM) intake and neutral detergent fiber (NDF) intake did not differ (P>0.05) among the diets. Higher intake of ether extract (EE) (P<0.05) was found for the corn silage based diet compared to the sugar–cane based diets. There was detected difference in the total carbohydrate (CHO) intake and in the non–fiber carbohydrate (NFC) intake between the corn silage diet and the sugar–cane based diets supplemented with 1.3 and 2 kg of concentrate. The heifers fed the sugar–cane diet supplemented with 2.0 kg of concentrate had the lowest TDN intake (2.89 kg/d) whereas the animals fed the corn silage diet had the highest (3.62 kg of TDN/d). Dry matter, organic matter and non–fiber carbohydrates digestibilities were not different (P>0.05) among diets. The digestibility of the crude protein (CP) of the corn silage diet was lower (P<0.05) than the CP digestibility of the three sugar–cane based diets (62.93 vs 75.10 %). No significant difference was detected (P>0.05) for total weight gain (TWG, kg) and average daily gain (ADG, kg/d) between the corn silage based diet and the sugar–cane diet supplemented with 2.7 kg of concentrate, with mean values of 71.22 kg and 0.847 kg/d. The other two sugar–cane based diets provided the lowest ADG (0.629 kg/d). Rumen pH, measured at 0 and 3 hours after feeding, did not differ (P>0.05) among the experimental diets. N-NH_3 , measured three hours after feeding, was lower (P<0.05) for the animals fed corn silage based diet compared to those fed sugar–cane based diets.

Key Words: Dairy Heifers, Rumen, Sugar-Cane

W291 Use of NutriDense corn variety for corn and corn silage in diets fed to high producing dairy cows. J. Sampson and J. Spain*, *University of Missouri*, *Columbia*.

This study evaluated a hybrid corn variety for corn silage and corn grain fed to high producing dairy cattle. Sixty-three lactating Holsteins were paired based on parity, stage of lactation, milk production, and body weight and randomly assigned to one of three dietary treatments. Control (CC) cows received total mixed ration (TMR) containing control corn silage (CS) and control corn grain. Group NDC received TMR containing NutriDense (ND) CS and control corn grain. Group NDND received TMR containing ND CS and ND corn grain. All three dietary treatments were formulated to meet NRC requirements for a 636 kg cow producing 41 kg milk/day containing 3.75% fat. Cows were fed twice daily with weights and feed refusals recorded. Cows were fed using electronic feeding gates (Calan Gates, American Calan, Inc.). Cows were fed assigned diets for 50d. Cows were milked twice a day and milk samples were taken weekly and submitted to DHIA to measure fat, protein, MUN and SCC. Body weights and condition scores were measured and recorded weekly. Blood samples were collected weekly to measure plasma glucose and urea nitrogen (PUN). A second experiment was conducted to evaluate ruminal fermentation of dietary treatments. Diets were subjected to digestion using standard in situ and in vitro techniques. Data collected were ruminal pH, optical density, and NH3-N concentrations as well as dry matter and nitrogen disappearance. Data were analyzed by Proc Mixed procedures of SAS. Average daily DMI was different (P=0.05; 22.03, 21.02, and 20.22 kg for CC, NDC, and NDND, respectively). FCM, milk fat, protein and SCC were not different (P=0.36, P=0.70, P=0.26, P=0.40, respectively). MUN and PUN were different by treatment (P=0.01, P<0.05, respectively) and by treatment over time (P=0.1, P<0.05, respectively). In situ N disappearance was also different due to treatment (P=0.0383), with higher values for NDND than CC or NDC (73.3%, 71.4%, and 71.9%, respectively). Ruminal NH3 concentrations were higher (P=0.02) for NDND than CC or NDC with values of 6.6, 5.9, and 6.2, respectively. Milk production efficiency was improved by ND hybrid.

Key Words: Corn Silage, Hybrid, Milk Production Efficiency

W292 Comparative effects of wild-type, *bmr*-6, *bmr*-12 and stacked sorghum: Sorghum stover digestibility. H. M. Dann*[1], A. M. DiCerbo[1], J. F. Pedersen[2], and R. J. Grant[1], [1]*William H. Miner Agricultural Research Institute*, *Chazy, NY*, [2]*USDA, ARS, NPA Wheat, Sorghum and Forage Research, University of Nebraska*, *Lincoln*.

Samples of wild-type 'Atlas' and its brown midrib near-isolines containing *bmr*-6, *bmr*-12, and stacked *bmr*-6 and *bmr*-12 genes were used to assess the effect of *bmr* mutations on in situ digestion kinetics of sorghum stover. Forage sorghum was grown in 2004 at Mead, Nebraska. Panicles were removed from sorghum before harvest. Wild-type, *bmr*-6, *bmr*-12, and stacked sorghum stovers had a neutral detergent fiber (NDF) content of 52.7, 53.1, 50.9, and 53.9%, respectively and a lignin content of 5.3, 3.8, 3.6, and 3.6%, respectively. Ruminal in situ digestion kinetics of dry matter (DM) and NDF of sorghum stover were determined with 4 ruminally cannulated multiparous lactating Holstein cows used in a 4×4 Latin square design. Samples of sorghum stover were incubated in N-free polyester in situ bags (5 g sample/bag) for 0, 6, 12, 24, 48, and 96 h and removed simultaneously at 0 h. Residues were analyzed for DM and NDF with residual ash (using α-amylase and without sodium sulfite). Digestion kinetics [lag, fractional rate of digestion (k_d), and potential extent of digestion (PED)] for DM and NDF were calculated. Data were analyzed by ANOVA. Dry matter lag (2.0 h), DM k_d (0.036 h_{-1}), NDF lag (2.8 h), and NDF k_d (0.036 h_{-1}) were similar ($P > 0.10$) among sorghum stovers. The PED of DM and NDF differed ($P < 0.05$) among sorghum stovers. The PED of DM was 52.1, 55.6, 64.3, and 73.2% and the PED of NDF was 53.1, 54.7, 65.3, and 74.1% for wild-type, *bmr*-6, *bmr*-12, and stacked sorghum stovers, respectively. Digestibility of NDF (% of NDF) was higher for stacked than wild-type sorghum stover at 24 h ($P < 0.10$; 49.0 vs. 39.1%) and 48 h ($P < 0.05$; 65.0 vs. 52.8%). In summary, there was more digestible DM and NDF in *bmr*-6, *bmr*-12, and stacked sorghum stovers than wild-type sorghum stover. The stacked *bmr*-6 and *bmr*-12 mutations had the greatest positive impact on digestibility.

Key Words: Sorghum, *bmr*, Digestibility

W293 Impact of the brown midrib (BMR) mutant gene on the nutritive value of sudangrass fed as forage to lactating dairy cows. D. N. Ledgerwood*, E. J. DePeters, P. H. Robinson, S. J. Taylor, and J. M. Heguy, *University of California*, *Davis*.

The BMR gene causes changes in lignin concentration and composition that have been demonstrated to increase fiber digestion in ruminants. Our objective was to assess potential benefits of the BMR mutant of Sudangrass, compared to the Piper variety, on production performance and digestibility in lactating dairy cows. The total mixed rations (TMR) contained 18% shredded Sudangrass hay, 18% sliced alfalfa hay with the remaining 64% representing the concentrate portion. The proportion of Piper to BMR in the TMR was varied as: 100:0, 66:34,

34:66, or 0:100. Four lactating dairy cows (251 ± 30 days in milk), fitted with ruminal and duodenal cannulas, were used in a 4x4 Latin square design with 14d adjustment and 7d sample collection phases. Individual feed intake and milk yield were measured daily during the collection phase, with fecal and duodenal samples collected 5 times over the last 3d of the collection phase. As the proportion of Piper to BMR decreased in the TMR, yields of milk and milk protein were highest at intermediate inclusion levels (Q: P=0.06/0.07), but milk fat, protein, and lactose contents, as well as dry matter intake, did not vary. Ruminal and total tract digestibility of ash-free NDF, organic matter, and cellulose did not vary as well. The optimal Piper:BMR Sudangrass ratio in this TMR with 18% Sudangrass was 66:34.

Table 1. Yield and NDF Digestibility

Diet [1]	100:0	66:34	34:66	0:100	S.E.	L[2]	Q[3]
Yield (kg/d)						P	P
Milk	29.9	32.3	30.8	30.3	0.68	0.91	0.06
Protein	0.95	1.02	0.97	0.95	0.03	0.68	0.07
NDF digestibility [4]							
Ruminal	53.6	54.8	52.2	57.3	3.93	0.64	0.63
Total Tract	60.4	60.3	61.9	64.9	2.55	0.23	0.56

[1] Piper : BMR = Proportion of Piper Sudangrass to BMR Sudangrass.
[2] L = Linear effect. [3]Q = Quadratic effect. [4] % of ash-free NDF intake.

Key Words: BMR, Sudangrass, Digestibility

W294 Use of computer simulation model to teach systems approach to metabolism. H. A. Johnson*, C. C. Calvert, and R. L. Baldwin, *University of California*, *Davis*.

Using a systems approach as embodied in the computer simulation model of a dairy cow, Molly (Baldwin, 2005) is ideal for teaching nutrition because there are many quantitative interactions among nutrients supplied and metabolic processes. Using Molly, undergraduate animal science students are able to observe effects of changing diets, altering genetic potential (e.g., milk production potential) and manipulating metabolism on whole cow metabolism. The objective is to show how Molly can be used in the classroom to teach a systems approach to nutrition using example simulations with and without administrating bovine somatotropin (BST) to cows at 2 levels of milk production (high and low), fed two different diets (Diet1 and Diet2). The table below shows results of the 8 simulations. BST increases milk production approximately 3000 kg, increases milk protein output 90-100 kg and increases milk fat yield 120-130 kg over 308 days. Diet2 results in higher milk production (300-400 kg) and higher milk protein (12-26 kg) compared to Diet1. Diet2 is higher in starch (2%) and insoluble protein (2%) which contributes to higher lactose (GlLmV) production increasing milk production and milk protein production. Higher producing cows respond less to BST in milk and milk protein production than lower producing cows. Diet causes little change in milk fat synthesis (AcTmV) relative to BST and increasing milk production. But, both increasing milk production potential and BST decrease lipogenesis (AcTsF, FaTsF) and increase adipose breakdown (TsFaF1) increasing the availability of fatty acids for milk fat synthesis (FaTmV). Therefore, BST increases udder synthetic capacity for milk lactose (GlLmV), milk protein (TAaLaV, TAaPmV) and milk fat (AcTmV and FaTmV). From these simulations, students are able to observe how manipulation of metabolism through diet, BST and genetic potential to produce milk changes milk production and whole body metabolism. Classroom handouts describing model settings, model output and the model program (Windows 98, 2000 or XP) are available at http://animalscience.ucdavis.edu/research/molly.

Table 1. Molly simulation results at 84 days

Parameter (mole/d)	Diet1, low, no BST	Diet2, low, no BST	Diet1, high, no BST	Diet2, high, no BST	Diet1, low, BST	Diet2, low, BST	Diet1, high, BST	Diet2, high, BST
AcTsF	12.0	13.1	7.27	8.02	8.71	9.39	5.06	5.60
FaTsF	6.37	6.39	5.76	5.81	6.22	6.26	5.51	5.58
TsFaF1	8.59	8.58	8.96	8.93	8.90	8.89	9.28	9.25
AcTmV	27.5	27.7	38.8	39.3	31.4	31.7	42.3	42.8
FaTmV	3.25	3.24	4.54	4.50	3.74	3.72	5.11	5.06
TAaPmV	11.2	11.7	14.2	14.7	12.4	12.7	15.4	15.9
GlLmV	11.6	11.9	14.5	15.0	12.6	13.0	15.7	16.2
TAaLaV	0.841	0.858	1.05	1.08	0.910	0.937	1.14	1.17

Key Words: Computer Model, Systems, Teaching

W295 Energy dilution of growing heifers' diet as a tool for induced negative energy balance in cattle. A. Arieli*[1], O. Eshel[1], U. Moallem[2], and Z. Uni[1], [1]*Hebrew University of Jerusalem*, *Rehovot, Israel*, [2]*Agricultural Research Organization*, *Bet Dagan, Israel*.

Our objective was to determine if energy dilution of growing heifers' diet is an appropriate model for inducing NEB in cattle. Four non-pregnant, non-lactating Holstein heifers (initial BW = 410 kg) were used in a 4 × 4 Latin square design trial with 21d periods to evaluate the effects of dietary energy dilution on: feed intake, energy balance and metabolic traits. Diets were based on a heifers mix (HMIX, 13% CP, 53% NDF, 1.35 Mcal NEL/kg DM). Control heifers (CON) were fed with diet containing 65% HMIX, 31% wheat straw and 4% SBM. The other diets contained 55% HMIX, 27% wheat straw, 3% SBM and 15% of either corn grains, barley grains or soy hulls supplements (COR, BAR and SOH diets, respectively). Blood samples were obtained weekly, 2 hours before morning feeding. Feed intake was monitored daily. Total tract digestibility was assessed by using indigestible NDF as a digestive marker, and energy values were based on DE. Intakes of DM and BW changes were similar among treatments and averaged 9.7 and 0.35 kg/d, respectively. Intake of DE, dietary concentration of DE, and ME intake above maintenance requirements were higher ($P < 0.05$) in supplemented diets than in CON (26.8 vs. 21.8 Mcal/d, 2.65 vs. 2.45 Mcal DE/kg of DM, and 11.9 vs. 7.3 Mcal ME/d). Blood NEFA and PUN were lower ($P<0.001$) and blood glucose was higher ($P<0.04$) in COR than in CON cows (105 vs. 185 meq/l, 8.3 vs. 9.9 mg/dl, and 85 vs. 80 mg/dl, respectively). Intermediate values were obtained for the corresponding blood metabolite concentration of BAR and SOH cows. Blood BHBA was similar among treatment, averaging 2.6 mg/dl. Significant correlations were found between ME intake above energy requirements and dietary DE concentration ($r = 0.75$. $P< 0.001$), and blood NEFA ($r = 0.68$, $P < 0.01$), indicating that NEB balance could be reached with diets diluted to less than 2.0 Mcal DE/kg of DM. These data indicate that energy dilution of growing heifers diet can be used as a tool for induced NEB in cattle.

Key Words: Heifers, Energy Balance, Dietary Energy Dilution

W296 Negative exponential models to predict dry matter intake of dairy heifers. P. C. Hoffman*, K. A. Weigel, and R. R. Wernberg, *University of Wisconsin*, *Madison*.

Daily pen dry matter intakes (DMI, n=9273) were collected over a 28 month period at the Integrated Dairy Research Facility of the University of Wisconsin-Madison. Forty, 4.5 × 9.0 m pens containing eight Holstein or Holstein × Jersey crossbred heifers were bedded with sawdust and provided access to 0.75 m of bunk space/heifer. Diets were formulated bi-monthly and fed to a common bunk score, with dietary nutrient densities, ambient temperature, and nutrient intakes recorded daily. Heifers were weighed at 60 d intervals, and mean pen body weights (BW) were adjusted for the number of days between the weigh intervals using average daily gain during the interval as a regression coefficient. Prediction of DMI was evaluated using first and second order random effects mixed models or non-linear models using the MIXED or NONLIN procedures of SAS, respectively. The effects of breed, BW, temperature and NDF deviation (from predicted mean dietary NDF for that BW) were considered as independent variables. Dietary NDF deviation was considered because dietary nutrients densities are codependent with BW. Preliminary mixed models suggested that NDF deviation was an independent source of DMI variance. The best DMI prediction was achieved with negative exponential non-linear models for Holstein and crossbred heifers. For Holsteins (R^2=0.87), the prediction equation was: DMI (kg/d) = 15.7930 * (1 - exp(-0.00210 * BW)) - 0.0820 * NDF deviation, where: NDF deviation = (dietary NDF as a % of DM) - (22.07020 + (0.08714 * BW) - (0.00007383 * $(BW)^2$)). For crossbred heifers (R^2=0.87), the prediction equation was: DMI (kg/d) = 13.4770 * (1 - exp(-0.00271 * BW)) - 0.0824 * NDF deviation, where: NDF deviation = (dietary NDF as a % of DM) - (23.11235 + (0.07968 * BW) - (0.00006252 * $(BW)^2$)). Alternative negative exponential DMI models when dietary NDF is unknown were also developed. The Holstein DMI equation (R^2=0.83) was: DMI(kg/d) = 15.3642 * (1 - exp(-0.00220 * BW)), where as the crossbred DMI equation (R^2=0.82) was: DMI(kg/d) = 12.9139 * (1 - exp(-0.00295 * BW).

Key Words: Heifers, Intake, Prediction

W297 Impact of corn particle size and forage source on nitrogen digestibility and partitioning in lactating Holstein dairy cows. N. E. Brown*, V. A. Ishler, T. W. Cassidy, K. Heyler, and G. A. Varga, *The Pennsylvania State University*, *University Park*.

The utilization of dietary nitrogen and the efficiency in which it is converted into milk protein has tremendous implications on productivity, profitability and environmental stewardship of dairy operations. A replicated 4 × 4 Latin square design was conducted to evaluate the effects of forage source and corn particle size on N digestibility, N partitioning and ammonia (NH_3) volatilization from manure in mid-lactation Holstein dairy cows. The four treatments were: 1) grass silage (G) with fine (F) ground corn (GF), 2) G with coarse (C) ground corn (GC), 3) alfalfa silage (A) with F (AF) and 4) A with C (AC) in diets for lactating cows. Diets were 50% forage on a DM basis with the treatment forage comprising 50% of the forage DM and corn silage making up the remaining forage. Approximately 40% of the coarse corn and 100% of the fine corn was able to pass through or remaining on a 16 inch sieve screen. Cows that were fed A based rations consumed and deposited greater N in milk (780 and 176 g/d respectively) compared to cows consuming G based rations (612 g/d and 142 g/d). The A based ration showed a trend (P < 0.09) for greater CP digestibility (57%) compared to grass based rations (53%); fecal N excretion for cows fed A based rations (347 g/d) was greater than cows fed G silage based rations (291 g/d). A trend (P<0.07) was observed for greater urinary N excretion for cows fed A based rations (272 g/d) compared to G based rations (243g/d). More of the dietary N was converted into milk protein for the G based rations (26%) compared to the A based rations (22%). Corn particle size had no significant impact on the digestibility or the partitioning of N into milk. Based upon NH_3 emissions measured, a total of 655 animals and 569 animals could be maintained on the G and A based rations respectively, resulting in the production of 100 lbs of ammonia, the threshold upon which dairy operations may be regulated.

Key Words: Corn particle Size, Nitrogen Partitioning, Ammonia Emission

W298 Evaluation of a corn replacement product in diets fed to lactating dairy cows. D. J. Rincker*[1], N. A. Janovick Guretzky[1], P. H. Doane[2], and J. K. Drackley[1], [1]*University of Illinois*, *Urbana*, [2]*ADM Animal Nutrition Research*, *Decatur, IN*.

Our objective was to determine the efficacy of a prototype product designed to replace corn grain in diets for lactating cows. The corn replacement product (CRP) was prepared by treating corn stover with CaO and water in an enclosed twin screw continuous mixer (Readco® Continuous Processor). The treated stover then was mixed with distillers grains (3:1 ratio) and pelleted. Multiparous and primiparous Holsteins (n = 13 per diet) were used in a complete randomized design trial with a 14-d standardization period and 33-d experimental period. Diets contained (DM basis) 40.0% corn silage, 10.0% alfalfa silage, 5.5% soybean hulls, and concentrates. Replacement of approximately 50% (Low; LCRP) or nearly all (High; HCRP) corn grain resulted in diets containing 11 or 22% of DM as CRP. Diets were isonitrogenous and isocaloric (if CRP was effective) with the control diet, which contained 16.5% CP and 1.71 Mcal NEL/kg. Dietary NDF was 33.3, 38.2, and 42.5% of DM for control, LCRP, and HCRP, respectively. The DMI decreased linearly (P < 0.001) as CRP increased (19.8, 16.7, and 14.3 kg/d for control, LCRP, and HCRP). Intake of NDF was similar for all diets (6.8, 6.1, 6.3 kg/d). Milk yield decreased (P =0.05) when CRP was fed (27.1, 23.6, 23.7 kg/d). Milk fat percentage was not affected by treatment (P > 0.20), but milk protein percentage and yields of milk solids decreased linearly with CRP (P < 0.01). Body weight was less for cows fed LCRP and HCRP versus control (P < 0.05), probably because lower DMI for CRP diets decreased gut fill. Calculated energy balance decreased linearly with CRP inclusion. Total tract apparent digestibilities of DM and energy were greater (P < 0.05) for LCRP than for control or HCRP. A combination of chemically treated corn stover and DDGS was not an effective replacement for corn grain in diets fed to mid-lactation cows.

Key Words: Corn Replacement, Corn Stover, Dairy Cows

W299 Effect of feed energy source on milk components in dairy cattle. M.-C. Ferland*[1], D. Lefebvre[2], and K. M. Wade[1], [1]*McGill University*, *Montreal, QC, Canada*, [2]*Valacta*, *Ste. Anne de Bellevue, QC, Canada*.

The objective of this study was to evaluate the effect of three different energy sources on the milk composition of dairy cattle. These energy sources were corn grain (CG), high-moisture corn (HMC) and Commercial concentrate (CONC). A total 9,163,240 test-day records from 570,083 Holstein cows from 5191 different herds, and 434,018 test-day records from 27,110 Ayrshire cows from 652 different herds covering a period of five years were obtained from the Québec dairy herd improvement agency (Valacta). In addition to test-day records, information on lactation, feed composition and feeding systems was also available. Diets with only one of the three sources as the sole source of energy supplement were included. For both breeds, cows consuming diets with HMC and CG tended to have higher milk yield, higher fat and protein content and lower MUN concentration then cows consuming diets with a CONC. Milk yield averages were 28.92 kg/day, 27.34 kg/day and 26.22 kg/day (for Holsteins) and 23.64 kg/day, 22.51 kg/day and 21.70 kg/day (for Ayrshires) for HMC, CG and CONC respectively. The equivalent fat % values were 3.87%, 3.87% and 3.76% (for Holstein) and 4.09%, 4.03% and 4.02% (for Ayrshires) for HMC, CG and CONC respectively. Milk protein % in Holsteins was higher on HMC and CG diets (3.35% and 3.34% respectively) compared to CONC diets (3.25%). There were negligible differences in the overall milk-protein values for Ayrshires; however, similar trends to those seen in Holsteins were observed from 75 to 305 DIM. The MUN content was higher for CONC compared to HMC and CG in both breeds. Holstein averages of MUN were 10.51 mg/dL, 10.86 mg/dL and 11.93 mg/dL while Ayrshire averages of MUN were 11.04 mg/dL, 11.20 mg/dL and 13.03 mg/dL for HMC, CG and CONC respectively.

Key Words: Feed Energy Source, Milk Components, Dairy Cattle Nutrition

W300 The effect of dry chopped alfalfa hay content on eating behavior, milk yield and components, and rumen fermentation in lactating dairy cows. D. D. Maulfair* and A. J. Heinrichs, *The Pennsylvania State University*, *University Park*.

The objective of this experiment was to evaluate the inclusion of dry chopped alfalfa hay in lactating dairy cow rations on eating behavior, milk yield and components, and rumen fermentation. Eight multiparous Holstein cows (79 ± 18 DIM initially; 660 ± 87 kg BW) were randomly assigned to replicated 4 × 4 Latin Squares. One square consisted of cannulated cows and the other, non-cannulated cows. During each of the four periods, cows were fed one of four diets that were chemically similar but varied in dry chopped alfalfa hay level. The forage DM content of each ration consisted of 50% corn silage and 5, 10, 20, or 40% dry chopped alfalfa hay. The remaining forage DM content was alfalfa silage (45, 40, 30, and 10% respectively). The other ingredients of the ration included: ground corn, canola meal, roasted soybeans, bypass protein blend, and a mineral/vitamin mix. The forage level for each ration was between 58 and 59% and the total ration DM was 49, 50, 52, and 56% for the 5, 10, 20 and 40% rations respectively. No significant differences ($P< 0.05$) were found in feed sorting, milk yield and components, DMI, and rumen pH among the four rations. This experiment indicates that there is opportunity to include dry chopped alfalfa hay in lactating dairy cow rations at rates up to 40% of the forage DM content (approximately 23% of total ration DM) without adverse effects on eating behavior, milk yield and components, and rumen fermentation.

Key Words: Forage Level, Feed Sorting, Ruminal pH

W301 Evening feeding improves nutrient digestibility and nitrogen balance in lactating cows. A. Nikkhah*, J. C. Plaizier, C. J. Furedi, A. D. Kennedy, G. H. Crow, and K. M. Wittenberg, *Department of Animal Science*, *Winnipeg, MB, Canada*.

The primary objective was to evaluate the impact of feed delivery at either 2100 h or 0900 h on nutrient digestibility and nitrogen (N) partitioning. Four multiparous and four primiparous midlactation Holsteins were used in a cross-over design with two 6-week periods. Each period consisted of 3-wk adaptation. Cows were offered a TMR containing 50% concentrate (DM basis). Total fecal and urine were collected during week-4 to determine the total tract nutrient digestibility and N partitioning. Dry matter intake and milk yield were also recorded. Data were analyzed as a Mixed model with the fixed effects of feeding time, parity, and the interaction. Compared with morning feeding, evening feeding improved ($P<0.05$) the apparent total tract digestibility of dry matter (63 vs. 60), N (65.5 vs. 63%), NDF (49 vs. 44%), and ADF (44 vs. 41%). Provision of fresh TMR at 2100 h instead of 0900 h increased N intake by primiparous cows (562 vs. 510 g/d). Urinary and milk N outputs, % of digested N, were lower ($P<0.05$) with evening vs. morning feeding suggesting improved body N retention. Consequently, N balance was improved by providing fresh TMR at 2100 instead of 0900 h (55 vs. -3.5 g/d). Milk protein percent (2.82 vs. 3.12%, $P<0.10$) and not yield (1.0 vs. 1.1 kg/d) was numerically lower in multiparous, but not in primiparous, cows fed at 2100 vs. 0900 h. Treatments did not significantly affect rumen microbial protein synthesis. Results suggest beneficial impacts of evening feeding on nutrient digestibility and N retention in lactating cows. Reduce N excretion via urine and feces by evening feed delivery may have environmental implications.

Key Words: Evening Feeding, Digestibility, Nitrogen Balance

W302 Time of feed delivery: A determinant of post feeding patterns in feed intake of lactating cows. A. Nikkhah*, J. C. Plaizier, C. J. Furedi, G. H. Crow, and A. D. Kennedy, *Department of Animal Science*, *Winnipeg, MB, Canada*.

We examined the effects of providing a higher (HC) or a lower concentrate (LC) total mixed ration at either 2100 h or 0900 h on post feeding patterns in feed intake of dairy cows. Four primiparous and four pluriparous tie-stall-housed Holsteins were used in a 4×4 Latin square design with four 3-week periods. Cows were not heat stressed at any time during the experiment. Each period consisted of 2-week adaptation. The concentrate portion was 62% for HC and 51% for LC diet (DM basis). Feed intake was monitored continuously for the entire trial using a data acquisition system (Grow-Safe 4000 Hardware). Data for week-3 of each period were analyzed as a Mixed Model. Time of feed delivery had no effects on total feed consumed. Feeding at 2100 h instead of 0900 h, however, remarkably increased the amount consumed within 3-h post feeding from 26 to 37% of total daily intake ($P<0.01$). The amount consumed within 6-h and 9-h post feeding were similar in 0900 h- and 2100 h-fed cows. By 12-h post feeding, however, 0900 h-fed cows had eaten 75% of their daily intake compared with 68% in 2100 h-fed cows ($P<0.01$). This difference remained significant at 21-h post feeding (83 vs. 76%), as well. Parity and diet did not interact with feeding time on diurnal feed intake patterns. Results introduce the time of feed delivery as a main determinant of post feeding patterns in feed intake of lactating cows.

Key Words: Feed Delivery Time, Feed Intake Pattern, Lactating Cow

W303 Feed sorting in dairy cattle: effects of forage content and dietary change. T. J. DeVries*[1], K. A. Beauchemin[1], and M. A. G. von Keyserlingk[2], [1]*Agriculture and Agri-Food Canada*, *Lethbridge, AB, Canada*, [2]*University of British Columbia*, *Vancouver, BC, Canada*.

The objective of this study was to determine whether the amount of forage in a TMR influences feed sorting by cows and whether the extent of this sorting changes as they adapt to a new diet. Six lactating Holstein cows, individually fed once per day, were provided in a crossover design with 2 diets (DM basis): 1) high forage diet (HF; 62.3% forage), and 2) low forage diet (LF; 50.7% forage). DMI, feeding behavior, and sorting activity were monitored for each cow on each diet for 7 d. Fresh feed and orts were sampled daily for each animal and subjected to NDF and particle size analysis. The particle size separator contained two screens (18 and 9 mm) and a bottom pan resulting in 3 fractions (long, medium and short). Sorting activity (for each fraction, NDF and physically effective fiber: peNDF) was calculated as the actual intake expressed as a percentage of the predicted intake. To determine if sorting occurred, each variable was tested for a difference from 100%. Cows on the LF diet had higher DMI (22.2 vs 19.9 kg/d; P=0.03), but they spent less time feeding (193.3 vs 220.5 min/d; P=0.02), which translated into a higher intake rate (0.15 vs 0.11 kg/min; P=0.02) compared with cows on the HF diet. Overall, sorting activity was greatest on the LF diet (P<0.001) with cows sorting for short particles (106.1%; P< 0.001), but against long particles (74.2%; P<0.001), medium particles (98.3%; P=0.001), NDF (97.1%; P<0.001), and peNDF (90.1%; P<0.001). On the HF diet, cows sorted against long particles (93.7%; P=0.07), NDF (98.9%; P=0.009), and peNDF (96.8%; P=0.03) and sorted for short particles (103.5%; P=0.001). Treatment*day interactions (P<0.1) occurred for sorting for short particles and against peNDF because it took cows 1 d to adjust their sorting behavior to the LF diet. These results indicate that cows rapidly adjust their sorting behavior when subjected to a dietary change and they exhibit more sorting for short particles and against long particles, NDF and peNDF when fed a LF diet.

Key Words: Sorting, Forage, Particle Size

W304 Understanding feed sorting by dairy cows. W. Z. Yang* and K. A. Beauchemin, *Research Centre, Agriculture and Agri-Food Canada*, *Lethbridge, AB, Canada*.

The sorting behaviour of lactating dairy cows was examined by compiling results from various studies. The diets in these studies contained alfalfa silage (AS), barley silage (BS) or corn silage (CS) cut coarsely or finely and mixed with either barley- or corn-based concentrate. Particle size of each TMR was determined using the Penn State Particle Separator with a top sieve (19-mm, long particles), middle sieve (8-mm) and pan. The physical effectiveness factors (pef; top + middle fractions) for the TMRs containing fine and coarse silages were (DM basis): 0.36 and 0.53 for AS diets, 0.33 and 0.41 for BS diets, and 0.30 and 0.56 for CS diets. The difference in the proportion of long particles between the TMR and the orts indicates whether cows select against or in favor of long forage particles. For AS diets, the proportion of long particles in the orts (19 and 25%) was higher (P < 0.01) than in the original TMR (6 and 10%) containing coarse or fine silages, respectively. The pef was also greater (P < 0.01) for orts (0.64 and 0.44) than for TMRs containing coarse and fine silages, respectively. However, for BS diets, the proportion of long particles (0.9 and 0.5%) and the pef (0.33 and 0.28) of the orts were smaller (P < 0.05) than in the original TMRs. For CS diets, the proportion of long particles in the orts (6.3 and 0.2%) was smaller (P < 0.01) than in the TMR (8.6 and 7.0%) for coarse and fine cut silages, respectively, when barley grain was fed. In contrast, the proportion of long particles in the orts (13.6 and 3.7%) was greater (P < 0.01) than in the TMR (7.6 and 2.3%) for coarse and fine silage, respectively, when corn grain was fed. Mean ruminal pH, measured using indwelling probes, was 6.29 for AS, 5.65 for BS, 5.49 for CS with barley grain and 6.04 for CS with corn grain diets. Dairy cows sort against long particles when fed AS or corn grain-based diets, but not when fed diets that lower ruminal pH. In the case of low ruminal pH, cows intentionally select long particles to meet their need for physically effective fiber.

Key Words: Physically Effective Fiber, Sorting, Dairy Cow

W305 Susceptibility of lactating dairy cows to ruminal acidosis depends on the proportion of forage in the diet. F. Dohme[1], T. J. DeVries[2], K. A. Beauchemin*[2], K. M. Krause[3], and K. S. Schwartzkopf-Genswein[2], [1]*Agroscope Liebefeld-Posieux, Research Station ALP*, *Posieux, Switzerland*, [2]*Agriculture and Agri-Food Canada*, *Lethbridge, AB, Canada*, [3]*West Virginia University*, *Morgantown*.

An experiment was conducted to determine the effects of the physically effective fiber content of the diet on susceptibility of cows to ruminal acidosis. Eight lactating ruminally cannulated cows were assigned to one of 2 diets (DM basis): high fiber (HF, 60% forage) or low fiber (LF, 45% forage). Following a 2-wk adaptation, ruminal pH was measured continuously for 9 d to determine the effects of an acidosis challenge. Total acidosis was defined as pH < 5.8 and moderate acidosis as pH < 5.5. After a 3-d baseline measurement period, feed was restricted to 50% *ad libitum* intake for 24 h. Following this restriction period, cows were provided with 4 kg of ground barley/wheat followed by *ad libitum* allocation of TMR (challenge day). Throughout the experiment, pH profiles were higher (P < 0.05) for cows fed HF compared with LF. During the baseline period, cows fed HF had higher mean pH (6.28 vs 5.85; P = 0.01) and shorter duration of total (2.2 vs 9.5 h/d; P = 0.003) and moderate acidosis (0.6 vs 3.1 h/d; P = 0.05). Both groups responded to the challenge in a similar manner as there were no day × diet interactions (P > 0.05) for any of the pH variables measured. Relative to the baseline period, pH drastically dropped on the challenge day, recovering 2 days later. On the challenge day, mean pH dropped by 0.25 pH units (P < 0.001), duration of total acidosis increased by 6.4 h/d (P < 0.001) and moderate acidosis increased by 5.9 h/d (P < 0.01) relative to baseline. Higher baseline ruminal pH profiles of cows fed HF helped reduce the extent of pH depression during the acidosis challenge. These results suggest that diets containing higher levels of physically effective fiber help maintain a higher ruminal pH, which helps prevent severe acidosis from occurring as a result of improper feed delivery.

Key Words: Acidosis, Ruminal pH, Physically Effective Fiber

W306 Diagnosis of acidosis in dairy cattle using milk fatty acid profiles. M. Craninx*[1], A. Beeckman[1], H. Van Laar[2], J. Martin-Tereso[2], and V. Fievez[1], [1]*Laboratory for Animal Nutrition and Animal*

Product Quality, Ghent University, *Ghent, Belgium*, [2]*Nutreco Ruminant Research Centre*, *Boxmeer, The Netherlands*.

Acute and/or subacute ruminal acidosis (SARA) manifests with low-roughage high-concentrate diets and sudden changes in diet or dry matter intake pattern. SARA is characterised by prolonged periods of depressed ruminal pH, which can be linked to a modified rumen microbial population. Previous experiments showed that the milk fatty acid (MFA) pattern can be used to assess rumen function, particularly the odd and branched-chain MFA as they are of microbial origin. Further, accumulation of biohydrogenation intermediates are dependent of rumen conditions. Results from experiments with high concentrate diets showed a rapid increase in trans-10 C18:1 (> 5 g / kg milk fat) when the average daily ruminal pH drops below 5.8. Milk C17:0 + C17:1 cis-9 and C15:0 are negatively, whereas iso C14:0 and iso C15: 0 are positively correlated with the rumen pH. This was applied for the interpretation of the MFA pattern of a cow in a feeding trial that became sick in the 3rd week of lactation, because of a severely disturbed roughage and concentrate intake pattern. The animal was fed a diet high in concentrate and ad libitum a forage mixture containing grass and hay silage. MFA (g/kg milk fat) in weekly pooled samples of the first 4 weeks showed a peak concentration of trans-10 C18:1 (0.31, 0.25, 2.55, 0.47) and trans-10 cis-12 CLA (0.008, 0.009, 0.035, 0.012) in week 3, which rapidly decreased when the cow was offered a standard Dutch dairy diet based on concentrate/grass silage/maize silage in week 4. Apparently, these MFA show potential as indicators of acute acidosis. The odd and branched-chain MFA pattern already showed changes in terms of an increased C17:0 + C17:1 cis-9 (0.83, 1.42, 0.94, 0.97) and a decreased iso C14:0 (0.076, 0.034, 0.033, 0.038) concentration before clinical symptoms of digestive disorders were obvious. These results are currently further explored for the development of an early-diagnosis-model for acidosis, based on the MFA.

Key Words: Acidosis, Milk Fatty Acids, Detection

W307 Subacute ruminal acidosis increases milk fat depression with diets supplemented with polyunsaturated fatty acids. O. AlZahal*, M. R. Or-Rashid, S. L. Greenwood, M. S. Douglas, and B. W. McBride, *University of Guelph*, *Guelph, Ontario, Canada*.

The objective of this study was to investigate the effect of subacute ruminal acidosis (SARA) and dietary soybean oil (SBO) interaction on milk fat content and yield. Six rumen-fistulated lactating Holstein dairy cows (639 ± 51 kg body weight) were used in the study. Cows were allocated into blocks based on DIM (early 80 d, moderate 135 d, and late lactation 206 d). Two dietary treatments, control diet (% DM, 40% corn silage, 27% mixed haylage, 7% alfalfa hay, 18% protein supplement, 4% ground corn, and 4% wheat bran) and SARA diet (% DM, 31% corn silage, 20% mixed haylage, 5% alfalfa hay, 15% protein supplement, 19% ground wheat, and 10% ground barley) were randomly assigned to each block. The trial consisted of a 4-wk pre-SBO period, a 3-wk SBO period, and a 3-wk post-SBO period. The control (n=3) and SARA (n=3) diets were fed throughout the trial and SBO (2% of previous week average DM intake) was added into the rumen through the fistula during the SBO period. Ruminal pH was continuously recorded and milk samples were taken 3 d per wk. Milk yield and DM intake were recorded daily. Data were averaged by week and analyzed by SBO period using PROC MIXED of SAS with repeated measures. The effect of SBO was tested by the contrast describing time (wk) and time by diet interaction. During pre-SBO period, time below pH 5.8, pH 6.0, and pH 6.2 and mean pH was different ($P < 0.05$) between control and SARA cows. Soybean oil addition depressed milk fat for both SARA and control cows (table 1). However, the significant interaction (table 1) denoted that the SARA cows had a greater milk fat depression. By wk 3 of SBO; milk fat % dropped 21% and 42% and fat yield dropped 21% and 49% for control and SARA cows; respectively.

Table 1. Effect of SBO on milk fat % and milk fat yield

	Control			SARA				*P* Value	
Item/wk	1	2	3	1	2	3	SEM	T[1]	T[1] × Diet
Fat, %	4.19	3.88	3.25	4.42	3.61	2.55	0.12	<.0001	<.0001
Fat, kg/d	1.22	1.21	0.96	1.36	1.12	0.75	0.06	<.0001	<.0001

[1] Linear effect of time.

Key Words: SARA, Milk Fat, Soybean Oil

W308 The effect of buffering dairy cow diets with limestone, Acid Buf or sodium bicarbonate + limestone on production response and rumen parameters. C. W. Cruywagen*[1], S. J. Taylor[2], and M. M. Beya[1], [1]*Stellenbosch University*, *Stellenbosch, South Africa*, [2]*Celtic Sea Minerals*, *Cork, Ireland*.

A high concentrate TMR, formulated to be potentially acidotic, was used to construct three dietary treatments in which Acid Buf, the skeletal remains of the seaweed *Lithothamnium calcareum*, was compared against limestone (Control) and sodium bicarbonate plus limestone. The diets contained 4 g/kg of Acid Buf or 3.5 g/kg limestone (Control) or 3.7 g/kg of limestone plus 8 g/kg of sodium bicarbonate, respectively. The response to treatment was measured using 6 rumen cannulated lactating Holstein cows allocated to treatments according to a 3 × 3 (n=2) balanced Latin square design, with three treatments and three periods. The total experimental period was 66 days in which every cow received each diet for a period of 15 days prior to a data collection period of 7 days. Rumen pH was monitored continuously every 10 minutes for 2 days using a portable data logging system and in-dwelling electrodes. During each data collection period, milk was collected and analysed for its solids and mineral content. Feed dry matter consumption was also recorded. The impact of treatment on rumen acidity was clearly visible, especially during the period from mid day to midnight when pH dropped to below 5.5 for a longer period (13 h) in the Control (limestone) treatment than in the Sodium Bicarbonate (7.7 h) and Acid Buf (4 h) treatments. The minimum rumen pH was lower for the Control (5.19) than for the Acid Buf treatment (5.42), while the pH for the Sodium Bicarbonate treatment (5.37) did not differ from the other treatments. Daily milk yield was 27.6^{a}, 29.1^{a} and 31.6^{b} liters/cow for the Control, Sodium Bicarbonate and Acid Buf treatments, respectively, with milk containing 38.6^{a}, 41.8^{b} and 42.1^{b} g/kg fat and 34.3, 33.8 and 34.7 g/kg protein. The trial indicated that supplementing the diet of dairy cows with approximately 90 g/day of Acid Buf may have a greater impact on rumen acidity and milk production than 180 g/day of sodium bicarbonate and that sub-clinical rumen acidosis could reduce daily milk output by 4 liters/cow.

Key Words: Acid Buf, Buffers, Rumen Parameters

W309 Ruminal temperature may aid in the detection of subacute ruminal acidosis. O. AlZahal*[1], E. Kebreab[1], J. France[1], M. Froetschel[2], and B. W. McBride[1], [1]*University of Guelph*, *Guelph, Ontario, Canada*, [2]*Edgar L. Rhodes Center for ADS, University of Georgia*, *Athens*.

Subacute ruminal acidosis (SARA) is a common condition in early lactating cows that is difficult to diagnose. The objective of this study was to investigate the relationship between ruminal pH and temperature (T) and to develop a predictive equation that may aid in the diagnosis of SARA. Six rumen-fistulated lactating Holstein dairy cows (639 ± 51 kg body weight) were used in the study. Cows were randomly allocated to one of two dietary treatments, control diet (%DM, 40% corn silage, 27% mixed haylage, 7% alfalfa hay, 18% protein supplement, 4% ground corn, and 4% wheat bran) and SARA diet (%DM, 31% corn silage, 20% mixed haylage, 5% alfalfa hay, 15% protein supplement, 19% ground wheat, and 10% ground barley). The trial consisted of 1 wk of adaptation and 1 wk of collection. During wk 2, ruminal pH and temperature were continuously recorded (every minute) for 4 d by an indwelling system. Daily average ruminal pH and temperature (table 1) was analyzed using PROC MIXED of SAS with repeated measures. The relationship between lowest pH point of the day and associated temperature was investigated using PROC MIXED considering intercept and slope for each cow as random effects and with repeated measures. SARA cows had greater ($P < 0.05$) average daily ruminal temperature and time (min/d) above 39.2 and 39.0 °C than control cows. Ruminal temperature had a negative relationship with ruminal pH and the random effect of cow was not significant:
pH = (16.9 ± 2.04) + (– 0.29 ± 0.052 T), $R^2 = 0.77$, n = 22, $P < 0.0001$.

Table 1. Ruminal pH and temperature summary

	Control	SARA	SE	*P* Value
pH				
Mean	6.17	5.84	0.05	<0.01
Max	6.68	6.54	0.05	0.09
Min	5.51	5.09	0.06	<0.01
[1]< 5.6	60	412	38	<0.01
< 5.8	174	687	74	<0.01
< 6.0	405	907	91	<0.01
Temp., °C				
Mean	38.54	39.21	0.22	0.05
Max	39.87	40.44	0.32	0.21
Min	36.70	36.75	0.23	0.89
[1]> 39.4	139	561	156	0.07
> 39.2 °C	263	723	149	0.04
> 39.0 °C	418	884	158	0.05

[1] Time (min/d) spent below () a given critical cut-off point.

Key Words: Dairy Cow, SARA, pH

W310 Evaluation of an intraruminal pH probe. B. A. Crooker*[1], W. J. Weber[1], S. C. Denham[2], and J. L. Vicini[2], [1]*University of Minnesota*, *St. Paul*, [2]*Monsanto Company*, *St. Louis, MO*.

Studies were conducted to compare rumen pH measurements from an intraruminal pH probe (IRP) to those obtained from a standard pH meter (M). Functional life and ability of IRP to detect changes caused by alterations in diet and feeding management were evaluated. The IRP (Well Cow, LTD, Bedford, UK) were calibrated prior to insertion and the M (Thermo Electron Corp., Beverly, MA) was calibrated before each use. Frequency (1 or 10 min) of measurement and data download from IRP were controlled through software on an external computer. The IRP (n = 2 or 3) were placed in the reticulum (R) or rumen of 3 lactating and 1 non-lactating cows for up to 28 d (Study 1). Measurements by M were obtained from R and ventral (V), caudal-ventral (CV) and caudal-dorsal (CD) sacs on d 0 to 5, 11, 23, and 27. Study 2 had three, 3-wk periods in which cows were fed a basal diet with sodium bicarbonate (B) 1X/d (continuous access to feed) and pH in R was compared with that of cows fed a) B with extra starch 1X/d, b) B as two discrete (3h) meals/d, or c) B without bicarbonate 1X/d. Each period had a 7 d transition (all cows fed B) and 14 d of treatment. The IRP (n = 2) were placed in R of 12 lactating cows blocked (n = 3) by DIM and milk yield. Results from IRP and M were compared using restricted maximum likelihood mixed model analysis. Means differed if $P < 0.05$. Mean pH by M differed by site (6.37, 6.28, 6.19, and 6.13 ± 0.04 in R, V, CV and CD, respectively) and time with no interaction (Study 1). When IRP functioned correctly, IRP and M values differed by less than 0.1 units but this was significant. Life of IRP was shorter (24.8 ± 1.5 and 28.6 ±3.6 d for Study 1 and 2, respectively) and overall failure (50% by 28 d) greater than expected. Daily mean pH was not altered by treatment. Mean daily decline in pH after feeding was greater in cows not fed bicarbonate (-0.57 vs. -0.44 ± 0.01). The minimum pH per day was less for cows fed 1X/d than 2X/d (6.29 vs. 6.44 ± 0.07). The IRP have potential to provide accurate, prolonged measurements of pH but their functional life needs to be increased.

Key Words: Intraruminal Probe, pH, Cow

W311 Role of effective fiber in reducing milk fat depression in lactating cows fed Rumensin. D. R. Mertens*, *U.S. Dairy Forage Research Center*, *Madison, WI*.

It is unclear how Rumensin (R) and effective fiber interact with high concentrate diets that lead to milk fat depression (MFD). Goals were to determine the effects of R when added to a milk fat-depressing diet and the role of effective fiber in alleviating MFD. Sixty-five cows were fed a typical dairy ration for one week, and then given a ration that was low in fiber for four weeks. After four weeks, 60 cows were blocked into fifteen groups based on parity, days in lactation, MFD, 4.0% FCM, and body weight. Cows were assigned diets in a randomized complete block design with a 2×2 factorial arrangement of treatments: two levels of NDF in the ration each fed with 0 or 14.6 g of R per ton of ration DM for 12 weeks. Low-fiber diets contained high moisture corn (HMC) and were formulated to contain 27% aNDF and 19% peNDF. Added effective fiber was 5% wheat straw, which was substituted for HMC. Amylase and sodium sulfite were used to measure amylase-treated NDF (aNDF). Physically effective fiber (peNDF) was calculated as (aNDF) × (fraction of DM retained on sieves with 1.18mm or greater apertures). Cows were milked twice daily and fed individually. Milk samples were taken every 3 to 4 days. Chewing activity was recorded during weeks 4, 9, and 12. Data was analyzed using PROC MIXED. Added fiber increased (P=.003) and R decreased (P=.039) milk fat. A fiber by R interaction (P=.022) was related to R having minimal effect on milk fat when the low-fiber diet was fed and adding 5% chopped wheat straw increasing milk fat less when R was fed. Compared to low-fiber diets, adding 5% chopped straw did not alleviate milk fat depression, with (2.61 vs 2.85%) or

without (2.69 vs 3.30%) R. Neither added fiber nor R affected milk yield, 3.5% FCM, SCM, weight gain, or DMI. Minutes of chewing per day were increased by added fiber. Rumensin decreased eating time, but increased rumination time. In conclusion, low-fiber diets (27% aNDF and 19% peNDF) containing >27% readily fermentable starch from HMC require more than 23% peNDF in the diet to achieve normal milk fat, especially with Rumensin.

Key Words: Monensin, Effective Fiber, Milk Fat

W312 Validation of an on-farm tool (Z-Box) for determining a physical effectiveness factor using a bioassay based on chewing activity and ruminal fermentation in lactating dairy cows. H. M. Dann*[1], K. W. Cotanch[1], M. P. Carter[1], C. S. Ballard[1], T. Eguchi[2], and R. J. Grant[1], [1]*William H. Miner Agricultural Research Institute*, *Chazy, NY*, [2]*Zen-Noh National Federation of Agricultural Co-operative Associations*, *Tokyo, Japan*.

A study was conducted to determine 1) the agreement of on-farm and laboratory methods for determining a physical effectiveness factor (pef) and 2) the effects of pef and physically effective neutral detergent fiber (peNDF) content of diets on intake, chewing activity, and ruminal fermentation in dairy cows. Sixteen lactating Holstein cows (4 ruminally fistulated) were fed diets (control, fine, medium, and coarse) in a replicated 4×4 Latin square design with 14-d periods. Diets varied in pef and peNDF content by altering the particle size and inclusion level of oat hay. The pef of the diets was determined with a laboratory dry vertical sieving method (standard) and an on-farm, as-fed method (Z-Box). The $pef_{Z\text{-}Box}$ was in agreement with the $pef_{Standard}$ with no mean bias ($P = 0.55$) or slope bias ($P = 0.65$) with regression analysis. Based on ANOVA, intake of peNDF, chewing time, and eating time differed among diets ($P < 0.05$). The relative change in cow chewing response between the control and treatment diets resulted in a pef (pef_{Chew}) that agreed with the sieving-derived pef for the fine and coarse diets. Diet did not affect > 0.05) mean ruminal pH (6.1) or ruminal concentration of total volatile fatty acids (132 m*M*). In summary, the Z-Box method provides pef values that are similar to the standard method and appears to be useful for predicting cow chewing response.

Table 1.

Item	Control	Fine	Medium	Coarse
$pef_{Standard}$	0.58	0.55	0.60	0.63
$pef_{Z\text{-}Box}$	0.53	0.56	0.58	0.61
pef_{Chew}	-	0.54	0.40	0.65
$peNDF_{Standard}$, %	16.7	19.0	21.2	23.1
$peNDF_{Z\text{-}Box}$, %	15.3	19.4	20.5	22.2
Intake, kg peNDF/d	3.9^{d}	4.4^{c}	4.8^{b}	5.2^{a}
Chewing, min/d	726^{b}	775^{a}	762^{ab}	795^{a}
Eating, min/d	260^{b}	284^{ab}	291^{a}	307^{a}
Ruminating, min/d	466	491	471	488
Chewing, min/kg peNDF	189^{a}	173^{b}	161^{bc}	153^{c}
Eating, min/kg peNDF	68^{a}	63^{ab}	62^{ab}	59^{b}
Ruminating, min/kg peNDF	122^{a}	110^{b}	100^{bc}	94^{c}

[abcd] Means within a row with unlike superscripts differ ($P < 0.05$)

Key Words: pef, peNDF, Fiber

W313 Use of a caliper to measure skinfold thickness in multiparous Holstein cows and its relationship to body condition score. H. M. Dann* and J. K. Drackley, *University of Illinois*, *Urbana*.

Skinfold thickness measurement is a quick, inexpensive, and commonly used technique for indirectly measuring subcutaneous fat in humans and might be useful for indirectly measuring subcutaneous fat in dairy cows. Seventy-four multiparous Holstein cows were used to 1) evaluate changes in skinfold thickness at seven locations from dry-off to 8 wk postpartum and 2) compare skinfold thickness to body condition score (BCS). Skinfold thickness (mm) was determined weekly with a caliper (The Body Caliper; The Caliper Company, Inc., Las Vegas, NV) on the thigh region of the leg, rear udder attachment, tailhead, 12th rib, shoulder, neck, and dewlap. All measurements were made on the left side of the cow except for the udder measurement. Hair was clipped with a size 40 surgical blade to eliminate variation associated with hair coat thickness. Body condition score was determined weekly. Skinfold thickness measurements and BCS were analyzed by ANOVA using the MIXED procedure of SAS to evaluate the effect of time. The CORR procedure of SAS was used to determine Pearson correlation coefficients between skinfold thickness measurements and BCS. Skinfold thickness of the dewlap, rib, shoulder, and tailhead and BSC changed ($P < 0.01$) from dry-off to 8 wk postpartum with higher values prepartum than postpartum. Skinfold thickness of the leg and neck did not change ($P > 0.05$). Skinfold thickness of the udder increased around parturition and then decreased as lactation progressed ($P < 0.01$). Measurements of skinfold thickness at the rib (r = 0.11), shoulder (r = 0.26), and tailhead (r = 0.46) were correlated positively with BCS ($P < 0.01$). Skinfold thickness measurements of the dewlap, leg, and neck were not correlated with BCS ($P > 0.05$). A skinfold thickness score, calculated as the sum of the skinfold thickness of the rib, shoulder, and tailhead, was correlated positively with BCS (r = 0.48; $P < 0.01$). Skinfold thickness is an objective measurement that can be used in addition to BCS to assess the body fat reserves of dairy cows.

Key Words: Skinfold Thickness, Body Condition Score, Dairy Cow

W314 Development of a method for measuring forage fragility. K. W. Cotanch*[1], R. J. Grant[1], J. Darrah[1], H. M. Wolford[1], and T. Eguchi[2], [1]*William H. Miner Agricultural Research Institute*, *Chazy, NY*, [2]*Zen-Noh National Federation of Agricultural Co-operative Associations*, *Tokyo, Japan*.

A method to determine forage fragility was developed using a ceramic ball mill to elucidate the relationship among resistance to physical breakdown, neutral detergent fiber digestibility (NDFd) and animal chewing response of various forages. The objective of this study was to 1) develop a ball mill method to quickly and accurately determine forage fragility based on particle size reduction and 2) investigate the relationship between forage fragility and NDF digestibility at 24 h ($NDFd_{24}$). A series of preliminary tests were run to determine optimal sample size relative to jar volume, amount of ceramic balls, and the length of milling time. Fragility was determined as percentage reduction in the physical effectiveness factor (pef), percentage of dry matter larger than 1.18 mm after ball milling, as determined by dry vertical sieving compared to that of the original sample. The final ball mill method required 600 ml of sample dried overnight at 55°C, 900 g of ceramic balls (n = 40) in a 5.5 L jar for 6 h of milling. A set

of 10 forages was assayed for NDF, acid detergent fiber (ADF), acid detergent lignin (ADL), and $NDFd_{24}$using the Ankom system. Samples included two corn silages, three haycrop silages, alfalfa hay stems, grass hay first and second cut, oat hay and wheat straw. Forage fragility (x) was moderately related to $NDFd_{24}$ (y) with $R^2 = 0.34$ and regression equation of y = 1.04x + 11.74. Forage fragility as determined with this ball mill method is moderately related with NDFd but has yet to be compared with actual cow chewing data.

Key Words: pef, peNDF, Forage Fragility

W315 Near infrared spectroscopy can be used to predict pH and concentrations of volatile fatty acids in fermented feeds. D. P. Casper*, D. Spangler, J. Horst, S. Gravert, and K. Thompson, *Agri-King, Inc.*, *Fulton, IL*.

The concentrations of volatile fatty acids (VFA's) and pH of ensiled feeds are routinely measured to determine the extent and quality of the ensiling process. Measurement of pH and VFA's in ensiled feeds can be slow and time consuming using wet chemistry methods. This preliminary study was conducted to determine if NIRS technology could be used to rapidly predict pH and concentrations of VFA's in ensiled feeds. Samples being submitted to Agri-King's analytical laboratory for determination of pH and VFA's via wet chemistry techniques (pH meter and capillary electrophoresis) were selected for this study. Samples were forced air dried at 55°C and ground through a .8 mm screen before being scanned by a Foss NIRS 5000 instrument. The paired data were subjected to a *t*-test using the proc means procedure of SAS. This preliminary study demonstrated that NIRS technology can be used to rapidly determine the pH and VFA concentrations in fermented feeds (Table 1).

Table 1. The wet chemistry (Lab) and NIRS predicted measurements of pH and VFA's in different ensiled feeds

Feed/Variable	# Obs	Lab	NIRS	Difference	P > t*
Haylage, pH	519	4.88	4.80	.08	.01
Lactic, %	489	5.62	5.69	.08	NS
Acetic, %	499	2.30	2.38	.01	NS
Corn Silage, pH	429	4.02	3.92	.10	.01
Lactic, %	417	4.80	4.80	<.01	NS
Acetic, %	405	2.31	2.25	.06	NS
Small Grain Silage, pH	148	4.46	4.41	.05	NS
Lactic, %	143	4.82	4.86	.04	NS
Acetic, %	143	2.30	2.17	.13	NS
High Moisture Corn, pH	39	4.92	4.88	.04	NS
Lactic, %	37	.67	.72	.05	NS
Acetic, %	40	.20	.16	.04	NS

*NS = $t > .10$.

Key Words: pH, Volatile Fatty Acids, NIRS

W316 Effect of lignin type, acid detergent lignin or Klason lignin, on rate and extent of NDF digestion. E. Raffrenato*, M. E. Van Amburgh, J. B. Robertson, and P. J. Van Soest, *Cornell University*, *Ithaca, NY*.

Lignification is widely known to negatively affect the extent of NDF digestion. However, it is not well known if lignin affects the rate of NDF digestion and further there is little known about the effect of soluble phenolics on the rate of NDF digestion. Therefore the objective of this study was to determine the relationship between acid detergent lignin (ADL) and Klason lignin (KL) with in vitro NDF digestion (IVNDFd) and rates of degradation (IVNDFd kd) among various forage types. Eighty five forages of various families (alfalfa, corn silage and grasses) were analyzed for NDF, ADL, KL and IVNDFd. Digestibility was measured at 6, 24, 30, and 96 hr. Correlations were estimated for all forage types between lignin type, lignin and extent of IVNDFd, and lignin type and IVNDFd kd and tested for significance ($P < 0.05$). Among all forage types, the correlation between ADL and KL was high and positive (0.77 to 0.90, $P < 0.05$). Within and among all forages, only ADL was consistently negatively correlated with IVNDFd at 24, 30 and 48 hours (-0.54 to -0.94). Results varied when relationships were analyzed between KL and IVNDFd. Correlation among forages for IVNDFd kd and lignin type were not consistent. Among all forages, KL was negatively correlated with IVNDFd and IVNDFd kd, and this was particularly true for bmr corn silages and mature grasses and less for conventional corn, early cut grasses, and alfalfa. The correlation between IVNDFd and ADL increased, as fermentation time increased among all forages (0.24 to 0.90), however, the correlation of KL and IVNDFd was greater early in the fermentation period (especially for Alfalfa and mature grasses), suggesting that the soluble phenolics affected both the rate and extent of IVNDFd. Compared with ADL, KL disappeared during IVNDF fermentation in alfalfas and grasses compared to corn silages. This data suggests that the acid soluble lignin potentially dilutes the NDF solubles and might impact the apparent energy content of the forage and will vary by forage type and maturity.

Key Words: Lignin, Digestibility, Neutral Detergent Fiber Rate of Digestion

W317 Estimating NDF rate of digestion: a comparison of different approaches for use in a first order model application. E. Raffrenato*, M. E. Van Amburgh, P. J. Van Soest, and J. B. Robertson, *Cornell University*, *Ithaca, NY*.

Digestion in ruminants can be empirically and mechanistically described by models of varying complexity. In models like the Cornell Net Carbohydrate and Protein System (CNCPS), rate of NDF digestion (kd) is an input variable in the feed library. However, estimation of kd as a commercial laboratory procedure has not been achieved, in part, because of lengthy analyses and statistical interpretation of fiber digestion. Most rates of NDF digestion have been computed assuming that digestion is complete at 96 hours and using nonlinear models. However, Chandler et al. (1980) estimated the indigestible NDF fraction as lignin times 2.4/NDF ($U_{2.4}$), after fermentation up to 120 d. The objective of this work was to compare non-linear and linear regression (ln-linear) approaches using the same time point fermentations, with and without estimation of the unavailable pool, and to present a mathematical approach for determining rates of digestion using a minimum of time points for commercial laboratory application. Data used for rate estimations were in vitro NDF fermentation residues, fermented for 6, 24, 30, 36, 48 and 96 hr from 90 forages. The ln-linear regression was applied to the data using 96 hr residue as the endpoint or the $U_{2.4}$ as the unavailable NDF fraction. The non-linear model resulted in simultaneous estimation of all parameters (lag, rate, available and

indigestible pools) when using 96 hr as an endpoint or was constrained to rate and lag when forced through $U_{2.4}$. The Levenburg-Marquardt algorithm was used to derive estimates for the non-linear models and uses the Gauss-Jordan procedure for the matrix inverse required in each iteration. The nonlinear approach was considered the least biased and correlations were compared to the nonlinear solutions. The correlation was high between the two nonlinear approaches (0.88) and ranged between 0.31 to 0.93 between the non-linear and ln-linear approaches. The single time point ln-linear approach provided the highest correlation with the non-linear approach when $U_{2.4}$ was used to estimate the available pool.

Key Words: Neutral Detergent Fiber Rate of Digestion, Modeling

W318 Urinary creatinine concentration during the periparturient period and the effect of correcting urinary creatinine concentration for DM content on the ability to predict total urinary output. G. Chibisa*[1], G. B. Penner[2], G. N. Gozho[1], and T. Mutsvangwa[1], [1]*University of Saskatchewan*, *Canada*, [2]*University of Alberta*, *Canada*.

The objectives of this study were to characterize changes in urinary creatinine excretion during the periparturient period and to determine if correcting urinary creatinine excretion for DM content improves the prediction for urine output. Sixteen pregnant cows were randomly assigned to one of two diets: 1. control (total mixed ration, TMR); and 2. TMR top-dressed with 600 ml/d of propylene glycol. Diets were fed from d -14 to d 49 relative to calving. Total urine output was collected using Foley catheters for 5 d starting on d -14 ± 5, d 15 ± 0, and d 38 ± 0 relative to calving. There were no effects of diet on any of the dependent variables measured (($P > 0.05$); therefore, the data were pooled to characterize changes relative to calving. Body weight decreased ($P < 0.01$) throughout the duration of the study, with mean values of 754, 658, and 635 kg at d -14, d 15 and d 38, respectively, relative to calving. An interaction between parity and day relative to calving was detected for urine output ($P = 0.01$) as both primiparous and multiparous had similar pre-partum urinary output (12.7 vs. 16.3 kg/d), whereas multiparous animals had greater urinary output at d 15 (26.7 vs. 18.1 kg/d) and d 38 (30.8 vs. 19.5 kg/d) compared to primiparous cows. Urinary DM content (mean 6.42%) was not affected by day relative to calving. Urinary creatinine concentration (mg/dl) corrected for DM was highest ($P < 0.01$) pre-partum and decreased until d 38 relative to calving. When urinary creatinine concentration was corrected for urinary DM content pre-partum, we observed a higher correlation coefficient ($r^2 = 0.50$) between creatinine concentration and total urine output when compared to using uncorrected (as-is) creatinine concentration ($r^2 = 0.35$). However, correlation coefficients at d 15 (0.73 vs. 0.69) and d 38 (0.72 vs. 0.69) postpartum were not different. These data indicate that physiological state affects creatinine excretion and that correcting creatinine excretion for DM content improves the ability to predict urinary output in cows.

Key Words: Urinary Output, Creatinine, Periparturient Period

W319 New analytical method indicates that purine metabolites may interfere in estimates of microbial flow. S. M. Reynal* and G. A. Broderick, *US Dairy Forage Research Center*, *Madison, WI*.

A new HPLC method was developed to determine concentrations of the purines adenine (A) and guanine (G) and their metabolites xanthine (X) and hypoxanthine (HX) in omasal digesta and bacterial samples and to assess the effect of using either purines or purines plus metabolites as microbial markers for estimating flows of N fractions from the rumen of dairy cows. Four ruminally-cannulated lactating dairy cows (mean DMI 25.6 kg/d) were assigned to a 4x4 Latin square and fed 16.7% CP diets supplemented with increasing amounts of sucrose (0, 2.5, 5, and 7.5% of DM) and decreasing amounts of starch (7,5, 5, 2.5, and 0% of DM). Digesta flow from the rumen was quantified using an omasal sampling technique and a triple-marker method. Individual purines and metabolites were separated using a C18 column with gradient flow rate and two mobile phases. The CV within assay ranged from 0.6 to 3.1%. Recovery of 4 purine bases from added nucleosides averaged 101% (nucleoside hydrolysis), 103% (bacterial isolates), and 104% (omasal digesta). Mean concentrations of A, G, X, and HX were, respectively, 53, 58, 2.8, and 3.5 µmol/g of DM in omasal bacteria and 10, 12, 7.5, and 7.5 µmol/g of DM in omasal digesta. Omasal N flows were not significantly affected by diet. Omasal flows of microbial and non-microbial N (g/d), and true ruminal digestibility of N (%) averaged, respectively, 284, 467, and 32 when estimated using purines; 449, 302, and 56 when estimated using purines plus metabolites; and 413, 209, and 69 when predicted by the NRC model. These results suggest that when total purines are used as a microbial marker, both purines and their metabolites should be determined and used in the calculations. Due to substantial differences in their extinction coefficients, concentrations of purines and metabolites should be determined individually by HPLC, precluding the use of the most common Zinn and Owens (1986) method. However, a portion of these compounds may be of dietary origin and their use as markers may result in biased estimates of microbial flow.

Key Words: Microbial N, Purines, Omasal Flow

W320 Comparative characterization of reticular and duodenal digesta in dairy cows and possibilities to estimate microbial outflow from the rumen based on reticular sampling. A. N. Hristov*, *University of Idaho*, *Moscow*.

The objective of this experiment was to investigate the possibility of estimating outflow of nutrients and microbial protein from the rumen based on sampling reticular contents as an alternative to duodenal sampling. Microbial protein flow estimates were also compared to a third method based on sampling of ruminal contents. Reticular and duodenal digesta and ruminal contents were recovered from 4 cows used in a 4×4 Latin square design experiment, in which the ruminal effects of four exogenous enzyme preparations were studied. Large and small particulate and fluid markers were used to estimate digesta flow in a triple-marker model; ^{15}N was used as a microbial marker. Reticular and duodenal digesta was segregated into small and large particles (SP and LP) and fluid phase and ruminal digesta - into particulate and fluid phases. Compared with digesta recovered at the duodenum, reticular digesta had lower OM ($P < 0.001$) and higher NDF content ($P < 0.001$ and $P = 0.031$; SP and LP, respectively). The proportion of microbial N was notably greater in the fluid phase of reticular digesta (by 78%; $P < 0.001$). Ruminal outflow of DM and OM were greater (by 17 and 28%; $P = 0.034$ and 0.028) and that of NDF lower (by 14%; $P = 0.020$) when estimated from duodenal than from reticular samples. There was no difference ($P = 0.315$ to 0.501) in the estimated flow of starch and non-ammonia and microbial N

(305 and 325 g/d, respectively) between the reticular and duodenal techniques. Microbial N flow estimated based on ruminal sampling was similar (P = 0.315) to those based on duodenal and reticular sampling. The ruminal method, however, grossly overestimated flow of DM, OM, and NDF. This study supports the concept that microbial protein outflow from the rumen can be measured based on sampling of ruminal or reticular digesta. The reticular sampling technique can also provide reliable estimates for ruminal digestibility of OM, N, and fiber fractions.

Key Words: Dairy Cow, Reticular Digesta, Microbial Protein Synthesis

W321 Kinetics of milk production as a function of energy and protein supplementation. R. P. Lana*[1,2], D. C. Abreu[1,2], P. F. C. Castro[1], B. Zamperline[1], and B. S. B. C. Souza[1], [1]*Universidade Federal de Viçosa*, *MG, Brazil*, [2]*CNPq*, *Brasília, DF, Brazil*.

Three experiments aimed to evaluate the effects of energy and protein supplementation on milk production by cows at the end of lactation, with suckling calves and consuming tropical grasses (6% CP and 2 Mcal ME/kg DM) during the dry season. Twelve-crossbred Holstein-Zebu cows (520 kg) were allotted in three-4×4 Latin squares, in four periods of seven days. The treatments consisted of increased levels of corn meal-CM (0.0, 0.85, 1.7 and 3.4 kg/cow/day), soybean meal-SM (0.0, 0.65, 1.3 and 2.6 kg) and grinded soybean grain-SG (0.32, 0.65, 1.3 and 2.6 kg). The concentrate supplements were fed twice a day, at milking time, and mineral salt was offered free choice. The experiments were analyzed as Latin square design including effects of treatments, animal and period. Although there were no treatment effects (P>.05), the mean data of milk production presented a curvilinear response to supplement levels, following a Michaelis-Menten relationship of enzyme systems, according to the next equations of Lineweaver-Burk:

Exp. 1: $1/Milk = 0.0384*(1/CM) + 0.168$ $r^2 = 0.91$

Exp. 2: $1/Milk = 0.0181*(1/SM) + 0.1956$ $r^2 = 0.99$

Exp. 3: $1/Milk = 0.0140*(1/SG) + 0.1165$ $r^2 = 0.98$

The theoretical maximum milk production (1/a) were 5.9, 5.1 and 8.6 kg/animal/day and the calculated amounts of supplements to reach marginal cost-benefit zero were 0.95, 0.6 and 0.9 kg for CM, SM and SG, respectively. The marginal increase in milk production reduced with increasing supplementation (0.97, 0.41 and 0.37 kg of milk/kg of CM; 0.79, 0.42 and 0.15 kg of milk/kg of SM; and -0.56, 0.81 and 0.37 kg of milk/kg of SG). The 2001 dairy NRC considers linear response of 2.3 kg of milk/kg of concentrate for both net energy of lactation and metabolizable protein supplementation, but models of saturation kinetics are more appropriate to explain these effects and to make nutrient recommendations.

Key Words: Energy, Protein, Supplement

W322 Effects of inoculation of ryegrass at ensiling on production of milk from dairy cows and whole body N partitioning. J. M. Moorby*, D. R. Davies, W. J. Fisher, and N. M. Ellis, *Institute of Grassland and Environmental Research*, *Aberystwyth, UK*.

To investigate the effect of inoculating grass at ensiling on subsequent feed intake and production characteristics of dairy cows, 18 multiparous mid-lactation Holstein-Friesian cows were used in a 3×3 Latin square design changeover experiment. Two silages were prepared from a single ryegrass dominated sward, with alternate trailer loads at harvest being left untreated or treated with an inoculant comprising a blend of bacteria and cellulytic enzymes before being used to fill two separate bunkers. Three dietary treatments were investigated, based on ad libitum access to ryegrass silage with 4 kg dairy concentrate/d: 1) the untreated grass silage, 2) a 1:1 mix (fresh) of the two silages, and 3) the inoculated grass silage. Of the 18 cows, half also underwent procedures to measure whole animal N partitioning and apparent whole-tract diet digestibilities. Results are in order of untreated, mixed, and inoculated silage treatments. There was very little difference in the composition of the forages (DM: 29.3, 28.4, 28.2 %; CP in DM: 21.3, 21.2, 21.3 %; NDF in DM: 48.1, 49.9, 49.9 %). Silage (and thus total) DM intakes were highest ($P < 0.05$) on the untreated silage (15.4, 14.7, 14.9 kg silage DM/d), although milk yields were not significantly affected by treatment (mean 26.8 kg/d). Milk fat % was lowest ($P < 0.05$) on the mixed diet (4.03, 3.92, 4.02 %), while protein % was highest ($P < 0.05$) on the inoculated silage diet (3.11, 3.15, 3.19 %). Nitrogen intake was highest ($P < 0.01$) on the untreated silage diet (644, 618, 594 g N/d) but daily outputs of N in urine, faeces and milk were all unaffected by treatment. Nitrogen balance was very significantly ($P < 0.001$) affected by treatment (121, 96, 58 g N/d). In conclusion, cows offered the inoculated silage ate slightly less food but produced the same amount of milk (with a higher protein %) as cows offered the untreated silage, while those offered the untreated silage accreted significantly more body N. Results from cows offered the mixed silage diet generally fell between the two extremes.

Key Words: Diary Cows, Ryegrass Silage, Inoculation

W323 Nitrogen utilization and nutrient digestibility in dairy cattle fed brown midrib corn silage and monensin. A. M. Gehman*, P. J. Kononoff, and B. N. Janicek, *University of Nebraska*, *Lincoln*.

Twenty Holstein cows (101 ± 34 DIM and 674 ± 77 kg BW) were used to compare rations containing brown midrib corn silage (*bm3*) to a control dual purpose hybrid (DP) on N intake and utilization. The effect of monensin in these rations was also examined. Animals were assigned to one of five 4 x 4 Latin squares with treatments arranged in a 2 x 2 factorial. Cows were fed one of four treatments during each of the four 28-d periods: 1) C-*bm3*, 0 mg/d monensin and *bm3*, 2) C-DP, 0 mg/d monensin and DP, 3) M-*bm3*, 300 mg/d monensin and *bm3*, and 4) M-DP, 300 mg/d monensin and DP. Indigestible acid detergent fiber was used as an internal fecal marker to determine nutrient digestibility, and urinary purine derivatives were used to estimate rumen microbial protein synthesis. N digestibility was ($P < 0.01$) lower for *bm3* compared to DP (61.9 vs. 65.6 %). Dry matter, acid detergent fiber, ether extract digestibility were ($P < 0.05$) and organic matter digestibility tended to be ($P = 0.07$) lower for *bm3* than DP. Neutral detergent fiber digestibility was not different (40.5 ± 2.42 %). There was no effect of hybrid on purine derivative:creatinine ratio (1.68 ± 0.07) or microbial protein synthesis (1140.1 ± 56.1 g/d). Cows consuming *bm3* tended to have ($P = 0.06$) higher N intake than those on DP (630.4 vs. 587.9 g/d). More ($P < 0.01$) fecal N was excreted by cows consuming *bm3* (240.5 g/d and 38.2 % N intake) than those consuming DP (204.1 g/d and 34.4 % N intake), however urinary N

(211.1 g/d and 35.8% N intake) and total manure N (431.5 g/d and 71.9% N intake) were not different. There was no effect of monensin or hybrid x monensin interaction on any measurements. The reduction in the digestibility of nutrients for *bm3* was probably attributed to increased dry matter intake observed for cows consumed *bm3*. This increase in dry matter intake appeared to have negatively affected N digestibility but not neutral detergent fiber digestibility. This resulted in a greater amount of N excreted in feces but did not affect total manure N excreted.

Key Words: Brown Midrib Corn Silage, Monensin, Nitrogen

W324 Effect of carbohydrates or amino acid infusions on plasma ghrelin in early and late lactating cows. I. Schei*[1,2] and H. Volden[1], [1]*Department of Animal and Aquacultural Sciences, Norwegian University of Life Sciences*, *Ås, Norway*, [2]*TINE BA*, *Ås, Norway*.

The objective was to study the effect of abomasal or intravenous infusions of wheat starch, glucose (CHO) or a mixture of amino acids (AA) on plasma ghrelin concentrations of dairy cows with different genetic capacity. Eight cows from two genetic lines selected for low (L) and high (H) milk production were used in a 4×4 Latin square design. The mean differences in pedigree index between the two groups were 1639 kg milk and 55 kg protein yield based on 305 d lactation. Infusions were: 1) starch in the abomasum (SP), 2) glucose in the blood (GB), 3) AA in the abomasum (AP), and 4) AA in the blood (AB). The experiment was conducted in early lactation (start: 57±4 and 52±2 d postpartum, 31.3±2.8 and 34.7±1.4 kg milk for L and H cows, respectively) and repeated with the same animals and treatments in late lactation (start: 168±4 and 162±2 d postpartum, 21.0±1.9 and 23.8±0.7 kg milk for L and H cows, respectively). Average daily amounts infused were 354 and 258 g in early and late lactation, respectively. The cows were fed a basal diet consisting of concentrate and grass silage (55:45 on DM basis) fixed to 95 % of the energy requirements for milk yield. Blood samples from the jugular vein were drawn at 0500, 0800 and 1200. Genetic group or genetic group × infusion interaction showed no effect (P>0.10) on plasma ghrelin concentration in early or late lactation. Across genetic group, average concentrations in early and late lactation were 560 (±17.2) and 512 (±19.7) pg\ml, respectively. In early lactation, the GB infusion tended to (P=0.10) be lower in plasma ghrelin concentration compared to the SP and AP infusions, but no effect (P>0.10) of infusion was found in late lactation. On restricted feed intake, plasma ghrelin concentration was similar for all cows when they were infused with starch or AA post-ruminal or intravenously but ghrelin concentration was slightly lower when glucose was infused intravenously in early lactating dairy cows.

Key Words: Genetic Capacity, Glucose, Starch

W325 Depression in feed intake by a highly fermentable diet is related to plasma insulin concentration and insulin response to glucose infusion. B. J. Bradford* and M. S. Allen, *Michigan State University*, *East Lansing*.

Effects of dietary starch fermentability on feed intake and nutrient digestibility were evaluated in a crossover study designed to identify factors that predict individual variation in feed intake response to starch fermentability. Thirty-two multiparous Holstein cows (121 ± 48 d in milk, 44 ± 7 kg/d milk yield; mean ± SD) were fed a diet intermediate to the treatments during a preliminary period and assigned randomly to treatment sequence. Treatments were dry ground corn grain (DG) and high moisture corn (HM) harvested from the same field. Treatment periods were 14 d, with the final 4 d used for data and sample collection. Diets included corn silage and alfalfa silage at a 2:1 ratio and were ~26% neutral detergent fiber, 17% crude protein, 32% starch, and 3.5% fatty acids. HM decreased dry matter intake (DMI) by 8% ($P < 0.001$), but did not significantly alter digestible DMI. Individual DMI responses to treatment were highly variable, ranging from an increase of 0.9 kg/d to a decrease of 6.0 kg/d when starch fermentability was increased. Variables from preliminary period propionate challenge tests, glucose tolerance tests, and hepatic mRNA analysis were assessed as potential predictors of DMI depression from increased dietary starch fermentability. Of the covariates tested, only plasma insulin concentration and insulin response to glucose tolerance test were significant predictors of DMI response to treatment. Higher plasma insulin concentration was related to greater depression in DMI with increased fermentability ($r^2 = 0.28$, $P < 0.01$); conversely, greater insulin secretion in response to glucose infusion was related to lower depression in DMI ($r^2 = 0.32$, $P < 0.01$). These insulin variables were independent predictors of DMI response ($r^2 = 0.001$). Consistent with past results, increased dietary starch fermentability decreased DMI. Significant correlations between insulin variables and individual DMI response warrant further investigation.

Key Words: Starch Fermentability, Insulin, Feed Intake

W326 Effect of weaning age on calving age, milk yield, and milk composition in the first lactation. J. A. Elizondo Salazar*, S. I. Kehoe, G. I. Zanton, C. D. Dechow, and A. J. Heinrichs, *The Pennsylavania State University*, *University Park*.

Average weaning age of dairy calves in the United States is approximately 8 wk. However, with proper management it has been shown that calves can be weaned as early as 3 to 6 wk saving time, labor, and cost. Research from many labs has shown that calves weaned at 4 to 6 wk were not different from calves weaned conventionally in feed intake, average daily gain, and feed efficiency. However, little is known about any effects that this could have on milk yield and composition. A retrospective analysis was used to determine effects of early weaning on calving age, milk production, and milk composition. The database included 40 Holstein heifer calves from 2 trials that studied effects of weaning age and milk feeding frequency on calf growth, health, and rumen parameters. Treatments consisted of weaning at 3, 4, 5, or 6 wk. In trial 1, calves were fed at 5% of birth BW, twice daily until 1 wk prior to weaning; and 5% once daily during the wk before weaning. For trial 2, calves were fed at 5% of birth BW twice daily until 14 d of age, then fed 10% of birth BW in the morning until 1 wk prior to their respective weaning age, at which time milk replacer was reduced to 5% of birth BW. After this time, calves were raised in the PSU Dairy Herd under a standard protocol. For the data analysis, DHIA records were compiled for age at calving, milk production and composition. Data were analyzed using the GLM procedure of SAS. Least squares means were calculated using sire, dam PTA fat%, and PTA fat% as covariates. No differences were detected in calving age or first lactation performance of calves weaned at 3 to 6 wk or fed once or twice daily. We conclude that weaning age or feeding system did not have any long term impacts on calving age or production.

Table 1. Calving age, milk yield, and milk composition in the first lactation of dairy cows in relation to weaning age

Item	Weaning Age (wk) 3	4	5	6	SEM	*P*
Number of calves	9	10	12	9	-	-
Age at calving, mo	24.1	23.2	23.1	23.2	0.40	NS
Milk, kg (305 ME)	13,212.6	12,771.2	13,856.2	14,754.3	545.7	NS
Fat, %	3.72	3.87	3.73	3.99	0.08	NS
Fat, kg	488.7	495.6	516.5	591.1	24.62	NS
Protein, %	2.92	3.05	3.02	3.00	0.05	NS
Protein, kg	385.5	388.9	417.3	440.8	15.20	NS

Key Words: Dairy Cows, Weaning Age, Milk Production

W327 Effects of dietary AflaDetox on aflatoxin M1 residue in milk of dairy cows. M. Denli*[1], J. C. Blandon[1], S. Salado[2], J. F. Perez[2], and S. Calsamiglia[1], [1]*Animal Nutrition, Management and Welfare Research Group, Universitat Autònoma de Barcelona*, *Barcelona, Spain*, [2]*Adiveter S.L. Agro-Reus*, *Tarragona, Spain*.

This study was conducted to evaluate the efficacy of a dietary mycotoxin adsorbent (AflaDetox, ADIVETER, S.L.) in reducing the excretion of aflatoxin M1 (AFM1) in milk of lactating dairy cows. Twenty five lactating Holstein cows from a commercial dairy farm were fed aflatoxin B1 (AFB1) contaminated feed in three experimental periods. AFB1 concentration in the total mixed ration (TMR) was 21 ppb. In Periods 1 and 3, animals were fed the TMR without AflaDetox, and in Period 2 animals were supplemented with AflaDetox at 1% (DM basis). Each experimental period consisted in 15 days adaptation and 3 days for sampling. Animals were fed a 55:45 forage (corn and triticale silage) to concentrate diet (17.9% CP, 32% NDF), respectively. Differences were declared at $P < 0.05$. Most of parameters studied were not affected by the inclusion of AflaDetox ($P>0.05$). Following values are average for the three periods; DM intake (21.9 kg/animal/day), milk production (27.9 ± 0.32 L/day), fat (3.85 ± 0.24%), protein (3.19 ± 0.27%) or somatic cell counts (290,700 ± 134.7 cells/mL), and serum activities of alanine amino transferase (33.8 ± 9.1 U/L), aspartate amino transferase (108.0 ± 19.4 U/L) and glutamly-transferase (16.9 ± 3.7 U/L). However, the addition of AflaDetox to the AFB1 contaminated diet reduced the concentration of AFM1 in milk from 250 to 100 ppt. Results from our experiment demonstrated that 1% AflaDetox in the diet can reduce up to 60% the concentration of AFM1 into milk of lactating cows fed AFB1 contaminated feed.

Key Words: Aflatoxin M1, Mycotoxin Adsorbent, Carry-Over

W328 *In vitro* aflatoxin binding efficiency of several sequestering agents in water or rumen fluids. F. Masoero[1], A. Gallo[1], D. E. Diaz*[2], G. Piva[1], and M. Moschini[1], [1]*Catholic University of Piacenza*, *Piacenza, PC, Italy*, [2]*Utah State University*, *Logan*.

The aflatoxins (AFs) are a group of mycotoxin produced primarily by *Aspergillus flavus* and *A. parasiticus*. Aflatoxin B1 (AFB1), the most frequently occurring and most studied of the AF is a Group 1 carcinogen and a potent hepatotoxin. Aflatoxin M1, a direct metabolite of AFB1, appears in milk of lactating dairy cows soon after consumption of AFB1 contaminated diets. The objective of this experiment was to measure the *in vitro* AFB1 binding efficiency of several sequestering agents used at different level of inclusion in water or rumen solutions. Three commercial sequestering agents, two clay based (clay 1 and clay 2) and a yeast cell wall derivate (CWD), were used at three different ratio with AFs (1:5000, 1:50000 and 1:500000 AFs:B) in water (CTR) or in rumen fluid (RF). The AFB1 was extracted from a natural contaminated corn meal (82.21±0.01 ppm), then added (0.205µg) to the binder suspension. Samples were incubated at 39°C for one hour under a light shake. Then, three 10 mL sub-samples were obtained, cooled down at 4°C to stop fermentation activity and centrifuged at 3500g for 15 minutes. The supernatant was recovered and the precipitate was suspended into 10 mL water before centrifugation. The step was cycled three times and the recovered supernatant was analyzed by HPLC for AFB1 content. Data were analyzed with factorial arrangement. Main effects (agent, substrate, dose), agent × dose and agent × substrate first order interactions and agent × dose × substrate second order interaction were significant at $P<0.01$.

Table 1. Sequestering agent (B) efficiency at different ratio with AFB1 (AFs:SA - 1:5000, 1:50000, 1:500000) in water (CTR) and rumen fluid (RF)

Solution	AFs:B	B Clay 1	Clay 2	CWD	SE	B	Main effect (P) Solution	AFs:B
CTR	1:5000	49.8	28.3	9.0				
	1:50000	66.0	53.5	33.9				
	1:500000	88.2	87.6	35.5	2.36	<0.0001	0.0088	<0.0001
RF	1:5000	57.6	15.9	14.8				
	1:50000	86.4	69.6	17.1				
	1:500000	99.7	98.1	20.7				

Key Words: Aflatoxin, Sequestering Agent, *In Vitro*

W329 Early lactation production, body condition, and incidence of disease in multiparous Holstein cows fed a low potassium diet supplemented with SoyChlor®16-7 prepartum. J. Siciliano-Jones[1], P. W. Jardon[2], M. Kucerak[2], and M. B. de Ondarza*[3], [1]*F.A.R.M.E. Institute*, *Homer, NY*, [2]*West Central®*, *Ralston, IA*, [3]*Paradox Nutrition, LLC*, *West Chazy, NY*.

The objective of the trial was to determine if feeding a chloride and protein supplement (SoyChlor 16-7) with a low potassium diet (<1.20% DM) for three weeks prior to calving would effect production, body condition, and incidence of disease during the first 90 DIM. Two hundred multiparous Holstein cows were paired based on expected calving date and estimated mature equivalent 305-day production and assigned to: 1) control treatment consisting of a low potassium diet with a forage base of straw and corn silage or 2) a low potassium diet with a forage base of straw and corn silage supplemented with SoyChlor16-7 (5.3-7.6% DM). Cows were housed in separate pens and fed differing rations for the prepartum period (-21 to 0 DIM) but were co-mingled after calving. Mean urine pH during the prefresh period was 6.61 and 8.02 for SoyChlor 16-7 and control cows, respectively. Plasma calcium levels in presumptively normal cows were significantly higher ($P<0.05$) for SoyChlor 16-7 cows than for the low potassium controls at 0 and 7 DIM (9.12 and 8.78 mg/dl serum, respectively). SoyChlor 16-7 supplementation had no effect on disease incidence

or body condition loss (P>0.20). SoyChlor 16-7 positively affected production of milk, milk protein, and milk solids (P<0.10). Significant treatment by parity interactions were noted for milk production, protein yield, and milk solids yield (P<0.10). These results suggest an improved transition for cows fed a SoyChlor 16-7 anionic ration compared with a low potassium control especially for third and greater lactation cows.

Table 1.

	Treatment Mean			P-value	
	Control	SoyChlor	SEM	Treatment	Trt*Parity
Milk, kg/d	41.2	41.8	0.346	0.0674	0.0712
Fat, %	3.60	3.59	0.037	0.7537	0.9478
Protein, %	2.79	2.79	0.017	0.9752	0.1299
Protein, kg/d	1.13	1.15	0.008	0.0218	0.0011
Milk Solids, kg/d	2.59	2.64	0.021	0.0980	0.0358

Key Words: Chloride, Urine pH, Transition Period

W330 Intake of oral histidine does not alter milk or milk component production in dairy cattle. N. G. Purdie*, A. Krueger, V. R. Osborne, and J. P. Cant, *University of Guelph*, *Guelph, Ontario, Canada*.

This experiment was designed to test the hypothesis that a sufficient proportion of amino acid included in the drinking water of lactating cows will bypass the rumen to have an effect on milk or milk component production. Histidine was selected as the amino acid to investigate as it has previously been shown to affect milk synthesis and it is an essential amino acid so that an increase in absorption of it from the intestine will be mirrored in its plasma concentration. Eight high-producing, early lactation, dairy cows were assigned to either 0 or 2.5 g/L histidine in the drinking water in a crossover design of 2 seven day periods. Cows were offered a corn and alfalfa silage-based TMR for ad libitum intake. Water was provided ad libitum to each cow in an individual automatic drinking bowl with a flow meter attached. Based on previous estimates of rumen bypass of ingested water, the histidine treatment was calculated to supply a bypass of 30 g/d histidine. Water intakes and milk yields were recorded, and milk samples were collected for compositional analysis, on each of the last 3 d of each period. Plasma samples were obtained on the last day of each period. Water intakes increased from 83 to 94 L/d (P = 0.014). Plasma histidine concentrations increased from 14.6 to 21.6 μM (P = 0.060) by the addition of histidine to the drinking water. Though inclusion of histidine in the drinking water elevated plasma histidine concentrations, there were no effects on milk, fat, protein or lactose yields or percentage composition of milk. The 7 μM increase in plasma histidine concentration indicates a lower rumen bypass of the drinking water than expected.

Key Words: Histidine, Rumen Bypass, Water

W331 Meta-functional genomics of the rumen biome. S. C. Fernando[1], H. T. Purvis, II[1], F. Z. Najar[2], G. Wiley[2], S. Macmil[2], L. O. Sukharnikov[2], T. G. Nagaraja[3], C. R. Krehbiel[1], B. A. Roe[2], and U. DeSilva*[1], [1]*Oklahoma State University*, *Stillwater*, [2]*University of Oklahoma*, *Norman*, [3]*Kansas State University*, *Manhattan*.

Microorganisms within the rumen play an important role in nutrient digestion. The synergistic relationship between the microflora and the animal provides the animal with nutrients that are not available to monogastric animals. The interaction between the animal and rumen microflora is a complex relationship which directly impacts the animal's efficiency and performance. Hence, understanding the relationships between the host animal and rumen microflora as well as understanding the functional role of these bacteria within the rumen is of critical importance. However, the current understanding of the functional role of rumen bacterial species is very limited. As a first step towards understanding the relative abundance of rumen microbial mRNA species and thus the putative function of rumen bacteria, we have sequence analyzed ~58,000 individual rumen microbial mRNA species. Initial sequencing results demonstrate a complex metabolic function within the rumen with <18% redundancy and only 11% of the transcripts with valid functional annotation suggesting significant diversity in microbial metabolism within the rumen. Out of the 11% transcripts that could be annotated, 57% show association with metabolic function where transcripts associated with carbohydrate metabolism, amino acid metabolism and glycan biosynthesis/metabolism predominate. Further, analysis of the poly-adenylated mRNA species reveals the functional role of eukaryotes within the rumen. This approach should greatly facilitate future studies of the rumen microbial function.

Key Words: Rumen, Functional Genomics, Bovine

W332 A meta-analysis on the effects of feeding malate to ruminants. E. M. Ungerfeld* and R. A. Kohn, *University of Maryland*, *College Park*.

Malate is an intermediate of propionate formation in the rumen. Malate addition to ruminant diets can benefit production by decreasing methane production in the rumen through the incorporation of reducing equivalents in its conversion to propionate. In addition, malate stimulates the uptake of lactate by *Selenomonas ruminantium*, which can result in an amelioration of lactic acidosis that occur when rapidly fermentable diets are offered to ruminants. The objective of this study was to examine the effects of malate on ruminant digestion, metabolism and performance through a meta-analysis of published studies where malate was added to beef, dairy or sheep diets. Random effects of experiment and its interactions with main effects were included in models, and data were weighted by the reciprocal of their coefficient of variation scaled to one. There were no effects of malate supplementation on DM intake. Average daily gain increased with malate addition until about 0.5% malate in DM and then declined. Gain over feed tended to slightly decline with more than 0.4% malate in DM. Total VFA concentration in the rumen tended to increase with malate, although the opposite response was observed in one experiment. Acetate molar percentage tended to increase and propionate unexpectedly to decrease with malate supplementation, and butyrate was unaffected. Also unexpectedly, high levels of malate supplementation increased ruminal lactate concentration, even though its addition increased ruminal pH as well as DM and ADF digestibility. There were no effects on N digestibility. There was a tendency toward lower blood glucose concentration with malate supplementation,

and no effects on blood urea-N or lactate concentrations. From this analysis, malate amelioration of rumen acidosis may not always be explained by lower lactate or VFA concentration. Changes in VFA profile differed from in vitro results and make it doubtful that added malate could have been a quantitatively important electron sink in vivo. Research is needed on mechanisms by which malate affects pH, and on the metabolism of added malate in the rumen.

Key Words: Rumen, Fermentation, Malate

W333 A multiple regression approach to explore the contribution of 2-hydroxy-4-methylthio butanoic acid or ruminally protected DL-methionine to production parameters for lactating dairy cows reported in the literature. G. R. Bowman*[1], M. Vázquez-Añón[1], and L. M. Rode[2], [1]*Novus International, Inc.*, *St. Louis, MO*, [2]*Sage Biosciences, Inc.*, *Alberta, Canada*.

A vast amount of research has been conducted on lactating dairy cow response to supplemental 2-hydroxy-4-methylthio butanoic acid (HMTBa) and ruminally protected DL-methionine (RPM). The objective of the study was to compile the research over the past 40 years and utilize a nutrient modeling program to explore predictive response equations for milk production, fat corrected milk (FCM), milk component constituents, and dry matter intake (DMI). There were 46 total studies in the database; 23 studies with 62 treatment comparisons used HMTBa and 23 studies with 48 treatment comparisons evaluated RPM. A step-wise multiple regression analysis was used to identify variables that significantly ($P < 0.1$) contributed to the prediction equation. Variables found to be significant were used to predict final equations for HMTBa and RPM independently using mixed model procedures. The average milk production, FCM, and DMI responses over control for HMTBa and RPM were; 0.23 kg, 0.83 kg, and 0.05 kg; and -0.28 kg, 0.09 kg, and 0.03 kg, respectively. HMTBa and RPM supplementation increased milk fat % (0.14 and 0.06 % units), milk fat production (0.05 and 0.01 kg), milk protein % (0.02 and 0.06 % units) and milk protein production (0.02 and 0.01 kg) over the control. Supply of HMTBa in the diet positively contributed ($P < 0.1$) to predicting FCM production, milk fat %, fat production, and protein production responses over control. Supply of RPM ($P > 0.1$) in the diet did not contribute to predicting any production responses. Dietary ether extract significantly improved ($P < 0.1$) and physically effective fiber ($P < 0.1$) and non-fiber carbohydrates ($P < 0.1$) significantly reduced HMTBa and RPM production parameters. In conclusion, HMTBa supplementation improved milk, FCM, milk fat and protein yield, where as RPM predicted production responses were not influenced by amount of RPM supplemented.

Key Words: HMTBa, DL-Methionine, Multiple Regression Analysis

W334 Effect of a phytase on *in vitro* digestibility and finishing Criollo lambs fed a high sorghum diet. G. Buendía–Rodríguez[1], G. D. Mendoza–Martínez[2], S. S. González*[1], E. Aranda–Ibáñez[1], L. Miranda–Romero[3], L. Melgoza–Contreras[2], and J. H. Avellaneda–Cevallos[4], [1]*Colegio de Postgraduados*, *Montecillo, Edo. México, México*, [2]*UAM Xochimilco*, *México D.F.*, [3]*Universidad Autónoma Chapingo*, *Chapingo, Edo. México, México*, [4]*Universidad Técnica Estatal de Quevedo*, *Quevedo, Ecuador*.

The objective of this trial was to evaluate the effect of a phytase (Natuphos-5000G, BASF Mexicana) on *in vitro* digestibility and performance of finishing Criollo lambs. For the *in vitro* digestibility trial a completely randomized design was used and treatments (0 or 0.15 mg phytase/g sorghum or corn) were compared with Tukey test ($P \leq 0.05$). For the *in vitro* digestibility trial, results for residual phosphorus concentration were as follows ($P \leq 0.05$): a) 0.061a, 0.055a sorghum, and 0.129a, 0.030b corn (for 0 and 0.15 mg phytase, respectively) at 24 h; b) 0.059a, 0.033b sorghum, and 0.093a, 0.032b corn (for 0 and 0.15 mg phytase, respectively) at 48 h. For the finishing trial, treatments (0, 150, 300, 450 g phytase/t DM) were randomly allotted to 32 Criollo lambs (21.47 ± 2.24 kg initial BW) fed a 70% sorghum grain diet and housed in individual metabolic cages during 60 d. Treatment means were compared with Tukey test. There were no significant differences ($P \geq 0.05$) between treatments for ADG (201, 220, 194, 198 g/d), DMI (995, 1166, 1078, 1149 g/d) or feed conversion (5.02, 5.39, 5.69, 6.03). It may be concluded that phytase improved only *in vitro* phosphorus availability but it did not change finishing lamb performance.

Key Words: Phytase, *In Vitro* Digestibility, Criollo Lambs

W335 Digestibility and blood parameters in growing goats offered high concentrate diets with different rice straw particle size. X. G. Zhao[1], B. Zeng[1], S. X. Tang[1], Z. H. Sun[1], Z. L. Tan*[1], Z. H. Cong[1], and G. O. Tayo[1,2], [1]*Institute of Subtropical Agriculture, The Chinese Academy of Sciences*, *Changsha, P.R.China*, [2]*Babcock University*, *Ikeja Lagos, Nigeria*.

This work had the objective of evaluating the effect of different particle sizes of rice straw (geometric mean: 0.97cm, SRS; 1.98 cm, MRS1; 3.93 cm, MRS2; 7.79 cm, LRS) on the total tract digestibility of NDF, ADF and CP, and blood variables of growing goats. Four goats at 6 months of age and an average weight of 24.5 kg were used in a 4 × 4 Latin square experimental design with 4 periods of 16 d each. The diets consisted of 40.0, 37.0, 9.4, 8.0, 2.0, 0.8, 0.2, 2.0 and 0.6% rice straw, corn grain, soybean meal, wheat bran, rapeseed meal, urea, salt, vitamin premix and dicalcium phosphate (DM basis), respectively. All goats were offered the feed at 90% of ad libitum intake to maintain no orts during the experimental period. About 20 ml of blood were collected from the jugular vein at the end of each experimental period for each goat. Apparent digestibility of NDF (P=0.04) and ADF (P=0.05) were higher for MRS1 than for SRS and LRS. Total tract digestibility of CP was not influenced by the particle size of rice straw. Goats offered the SRS diet had higher (P=0.02) serum insulin when compared with goats offered MRS1 and LRS (36.8 vs 28.0 and 28.4 μU/ml). Serum glucagon concentration was lower in goats fed MRS1 diet than those fed MRS2 (258.4 vs 319.4 pg/ml). There were no differences in blood glucose, urea nitrogen and growth hormone concentrations among the four treatments (P >0.05). It was concluded that the particle size of dietary rice straw probably affected fiber digestion but did not influence serum biochemical parameter concentrations.

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Key Words: Digestibility, Blood Parameter, Particle Size

W336 Effect of acetylated soybean peptides on ruminal fermentation and nitrogen metabolism in sheep. Z. J. Cao*, L. S. Li, Y. J. Wang, and M. Ma, *China Agricultural University*, *Beijing, China*.

The objective of this experiment was to determine the effect of acetylated peptides on rumen fermentation and nitrogen metabolism in sheep. Six adult Poll Dorset cross sheep, fitted with permanent rumen and duodenum fistulas, were used in a replicated 3×3 Latin design experiment. Three basic diets, balanced to similar nitrogen intake, were supplemented with 100 g soybean meal (ST), 60 g soybean peptides (PT), or 80 g acetylated soybean peptides (AT). Experimental periods were 15 d in duration (10 d of treatment adaptation and 5 d of data collection). The crude protein of soybean peptides and acetylated peptide powder were 66.8% and 51.0% (based on DM). The acetylatic degree was 88.9%. PT had the highest pH value (6.94), followed by AT and ST (6.74 and 6.58, $P < 0.01$). Ruminal ammonia concentrations were affected by treatment (8.25, 10.18 and 14.98 mg/dL for AT, PT and ST, respectively, $P < 0.05$). AT had higher free amino acid (FAA) concentrations compared to ST and PT ($P < 0.01$). Peptide amino acid (PAA) concentrations were higher (522.36 vs 122.81 mg/ L, $P < 0.01$) for sheep fed AT than ST. Methionine in total amino acids (TAA) was higher in AT compared to ST (0.45 vs 0.26 g/d, $P < 0.05$). Blood urea nitrogen (BUN) of ST had the highest value compared to PT and AT (5.96, 4.14, and 2.90 mmol/L, $P < 0.05$). Nitrogen losses from the feces of AT were less than that of ST (4.54 vs 6.44 g/d, $P < 0.05$). Similarly, nitrogen losses from the urine were higher for ST than for PT or AT (7.68 vs 5.19 and 5.01 g/d, $P < 0.05$). Apparent nitrogen digestibility of PT and AT (70.53 and 73.51%) was significantly higher than that of ST (62.85%, $P < 0.01$). Based on the results of this study, acetylation of the N-terminus of peptides can protect dietary peptides from rumen degradation. Ruminants might benefit more from acetylated peptides supplementation because of low degradability in the rumen and high digestibility in the intestine.

Key Words: Acetylated Peptides, Nitrogen Metabolism, Sheep

W337 Effects of rearing system on performance of weaned Pelibuey lambs. E. Gonzalez*[1,2], J. Arece[2], O. Cáceres[2], and P. P. Gomarín[2], [1]*INRA Antilles-Guyane*, *Domaine Duclos, Petit Bourg, Guadeloupe, France*, [2]*Estación Experimental de Pastos y Forrajes 'Indio Hatuey'*, *Central España Republicana, C.P., Matanzas, Cuba*.

A silvopastoral grazing system was compared with confinement (CF) for growth and general performance of weaned Pelibuey lambs. Lambs were from the EEPF 'Indio Hatuey' flock of Matanzas, Cuba (22°48′N, 81°2′W; 60 m above sea level). Ewes lambed in October and November and grazed at 12 to 14 per ha in a rotational silvopastoral system composed of three grasses distributed by plots ((*Panicum maximum*, *Brachiaria decumbens* and *Andropogon gayanus*) and three fodder trees (*Leucaena leucocephala*, *Albizia lebbeck* and *Bauhinia* spp.) randomly distributed in the 4.5 ha of pasture. Ewes were supplemented during drought with dehydrated citrus pulp (dcp) and sugarcane molasses containing 2% urea. The trial began with weaning in March and April about 3 months after lambing, with the lambs weighing 13 to 15 kg, and continued for 125 days. After being drenched with Levamisol, 25 lambs were grown on the silvopastoral system described above (SP) with 18 to 21 lambs/ha and 25 lambs were grown in confinement (CF). A rustic shed was used for CF with 1.5 to 1.8 m^2 per animal and *ad libitum* fresh water. The CF lambs were fed cut and carried chopped forage (60% *Pennisetum purpureum*, 40% *Morus alba*) and dcp at 0.8 to 1.0 kg/lamb per d. Data were analyzed by one-way analysis of variance. For the whole experimental period differences ($P < 0.0001$) were obtained for ADG (48.2 vs. 88.5 g/d) and incidence of gastrointestinal parasitism, mainly from *Haemonchus contortus* (2117 vs. 144 EPG of feces) for SP and CF feeding systems, respectively. Morbidity rate (data not available) was explicitly higher in SP (*i.e.* worse lamb external appearance), and consequently, the survival level was better under CF conditions (8% mortality in SP vs. 0% in CF). Advantages of the CF feeding system were mainly related to reduced *Trichostrongyle* numbers, which influence feed intake and efficiency, morbidity, growth rate, and survival. These results suggest that CF of lambs is a good alternative for improving the growth and welfare of lambs in the tropics.

Key Words: Lambs, Silvopastoral System, Confinement System

W338 Evaluation of growth and carcass characteristics of pure Pelibuey sheep and their cross with Dorper and Katahdin breeds. J. G. Canton* and J. A. Quintal, *Instituto Nacional de Investigaciones Forestales Agricolas y Pecuarias*, *Merida, Yucatan*.

Growth and carcass characteristics of purebred Pelibuey ram lambs were compared with those of Dorper $/times; Pelibuey and Katahdin × Pelibuey ram lambs. Thirty-four Pelibuey, 25 Dorper × Pelibuey and 20 Katahdin × Pelibuey lambs were included in a completely randomized experiment. Lambs were feed a diet composed of 27% of DM as orange pulp silage, 12% of DM as cut and carried Taiwan pasture, and 61% of DM as concentrate. At the end of the 68-d experiment, 3 animals of each breed group were slaughtered to measure carcass characteristics. Estimated DMI were 1143, 1266, and 1180 g/d and final BW ($P > 0.05$) were 40.9, 41.9, and 40.3 ± 1.1 kg, for Pelibuey, Dorper × Pelibuey, and Katahdin $/times; Pelibuey, respectively. No significant differences were detected for ADG, carcass weight, or dressing percentage. The average values obtained for all breeds were 232 g/d, 21.6 kg, and 55.1%, respectively. A higher ($P < 0.05$) percentage of loin and rib weight was observed in Pelibuey and Dorper × Pelibuey, compared with Katahdin × Pelibuey breeds (9.2 and 9.4 vs. 8.9 ± 0.5 %, respectively). There was no breed effect on area of the loin eye, or on proportions of neck, shoulder, leg, or total fat of the carcass. From these results, we conclude that pure Pelibuey sheep have growth rates and carcass characteristics similar to F1 crosses with Dorper and Katahdin breeds.

Key Words: Sheep, Growth, Hair Sheep

W339 Growth and feed efficiency of F1 Pelibuey lambs crossbred with specialized breeds for commercial production of meat. J. G. Canton*[1], R. F Bores[1], J. J. Baeza[1], J. A. Quintal[1], R. H. Santos[2], and C. A. Sandoval[2], [1]*Instituto Nacional de Investigaciones Forestales Agricolas y Pecuarias*, *Mérida, Yucatán*, [2]*Universidad Autónoma de Yucatán*, *Mérida, Yucatán*.

Growth and feed efficiency were evaluated for F1 crossbred ram lambs from different genotypes: Pelibuey × Pelibuey (PbPb), Black Head Dorper × Pb (BHDPb), White Dorper × Pb (WDPb), Katahdin $/times; Pb (KdPb) and Ile de France x Pb (IFPb). Forty-five lambs were distributed in a randomized block design with a factorial arrangement of 5 genotypes and 3 concentrations of dietary ME at 2.2, 2.5 and 2.8 Mcal/kg DM. There were two periods representing the initial (33 d) and the final phases (42 d) the growth, with 18 and 14% dietary crude protein, respectively. The IFPb lambs had a higher ($P < 0.05$) DMI than PbPb, BHDPb and WDPb lambs, but no differences were found ($P > 0.05$) between IFPb and KdPb. The values were 75, 76, 79, 80 and 86 g/kg$^{0.75}$ per d, for the PbPb, BHDPb, WDPb, KdPb and IFPb lambs, respectively. No effect on DMI was detected for the level of energy in either the interaction of genotype or main effect. There was a higher DMI ($P < 0.05$) in the final phase of growth (74 vs 84 g/kg$^{0.75}$ per d). No genotype effect was observed for ADG, total weight gain, or feed conversion. A linear effect ($P < 0.05$) was detected for ADG with increasing level of ME. The values obtained were 157, 193 and 240 g/d, for 2.2, 2.5 and 2.8 Mcal ME/kg DM, respectively. Lambs fed the medium and high ME levels had better ($P < 0.05$) feed conversions (4.3 and 5.0, respectively) compared to lambs fed at the lowest level of ME (6.5). Lambs had a lower ($P < 0.05$) total gain (5.6 vs. 8.1 kg) but better ($P < 0.05$) feed conversion (4.9 vs. 5.7) in the initial period than in the final period. Pelibuey lambs have growth and feed efficieny values similar to those of the specialized meat breeds, indicating that the Pelibuey breed can be used for commercial production of meat.

Key Words: Sheep, Crosses, Growth

W340 Introduction to Merino breeding resource flocks at Rafter 7 Ranch in Nevada. T. Wuliji*[1], H. Glimp[1,2], W. Jesko[2], and W. Rauw[1], [1]*University of Nevada*, *Reno*, [2]*Rafter 7 Ranch, The Edwin L Wiegand Trust*, *Yerington, NV*.

A Merino breeding resource flock was established at Rafter 7 Ranch through cooperation of the College of Agriculture, Biotechnology and Natural Resources, UNR and The Edwin L Wiegand Trust in 1990. Initially, 500 Rambouillet ewes were purchased from two established breeders in 1990. These ewes were bred naturally or by AI to imported rams from Australia and to rams selected within the flock. Over the 16 years, 16 rams and semen from 41 rams have been imported from Australia. Selection was based on objective wool measurements and phenotypic performance traits. Merino crossbred ewes showed that wool fiber density, clean wool yield, staple length, and grease fleece weight were increased by 41% per unit area of skin, 15%, 2.5 cm, and 1.14 kg per head shorn, respectively. The current flock wool fiber diameter was reduced by 3 micron on average compared with the foundation flock (23 micron). The flock was expanded to 1200 ewes and was bred in 30 single sire mating groups in 2006. Presently, the Merino flock is managed in two breeding lines, one as a registered Merino flock (n = 600) and the other as Rafter 7 line (n = 600), which is selected for wool, lambing, and meat production traits. Wool sales from Rafter 7 Ranch won 7 consecutive annual shears for the highest price in US grown wool. The 5 finest bales of wool clips in 2006 averaged 16.9 um fiber diameter. Sheep producers from 17 states and Canada have purchased breeding rams and ewes from Rafter 7 ranch over the past 10 years. These resource flocks have made significant progress over the foundation ewe flock during the crossbreeding and upgrading phase in major selection traits and are now becoming the flagship Merino flocks in the western states. Wool industry experts project that wool fiber diameter and its associated wool characteristics will continue to dominate wool price and textile use. Therefore, genetic improvement in wool and meat traits will increase sheep industry profits, and Rafter 7 ranch is poised to contribute genetic advantages to region-wide wool and sheep enterprises.

Key Words: Merino, Wool, Breeding

W341 Evaluation of Saint Croix ram lambs for growth, feed efficiency, blood urea nitrogen, and glucose levels by multivariate analysis. J. Simroth-Rodriguez*[1], E. Gutierrez-Ornelas[1], H. Bernal-Barragan[1], H. Morales-Treviño[1], J. Colin-Negrete[1], and V- Torres[2], [1]*Facultad de Agronomia, Universidad Autonoma de Nuevo Leon*, *Marin, Mexico*, [2]*Instituto de Ciencia Animal*, *Apartado Postal 24, San Jose de las Lajas La Habana, Cuba*.

Seventeen Saint Croix ram lambs were evaluated using a combination of growth and feed intake responses, and blood urea N (BUN) and glucose (BG), using multivariate analysis to identify and select those more efficient rams. The growth period was 102 d. Ram lambs (initial body BW: 13.7 ± 1.9 kg) were allocated into individual pens and fed a diet containing 18.7% CP and 2.65 Mcal of ME/kg, composed of ground sorghum grain (53.6%), soybean meal (15.2%), alfalfa hay (5%), wheat bran (15%), cane molasses (6%), tallow (1.5%), urea (1%), and vitamin-mineral premix (2.7%). Blood samples were obtained every 14 d and blood serum was analyzed to obtain BUN and BG levels. Five groups were discriminated by the hierarchical cluster method (Table 1). Group 4, with only one animal, was considered as the best. It had better data for birth type, birth weight, and weaning weight, as well as scrotal circumference, daily feed intake, ADG, feed/gain, and average BUN and BG levels measured throughout the growth period. The use of this method as a selection technique may represent a practical and useful tool for ram lamb selection in situations where scarce information is available.

Table 1. Characteristics of discriminate groups

Discr. group:	1	2	3	4	5
N	5	8	1	1	1
Birth weight, kg	3.4	3.8	4.6	3.3	4.1
WW, kg	12.8	14.5	18	12	12
ADG, g/d	221	231	247	272	197
FI, kg/d	1.2	1.1	1.3	1.1	0.9
Feed/gain	5.8	5.1	6.8	5.2	6.3
SC, cm	29.4	30	27	32.5	—
BUN, mg/dL	27.1	26.0	30.6	29.5	25.2
BG, mg/dL	83.1	70.4	76.5	74.3	78.8

WW: weaning weight; **FI:** feed intake; **SC:** scrotal circumference; **BUN:** blood urea nitrogen; **BG:** blood glucose.

Key Words: Ram Lambs, Multivariate Analysis, Performance Trial

W342 Effect of dried distillers grains substituting for corn-soybean meal on growth and feed intake of Pelibuey sheep. A. Estrada-Angulo*[1], G. Contreras[1], A. Perez[1], G. Gamez[1], O. Lozano[2], F. G. Rios[1], and E. Vazquez[1], [1]*FMVZ - UAS*, *Culiacán, Sinaloa, Mexico*, [2]*Ganadera Flexi*, *Culiacán, Sinaloa, Mexico*.

To determine the effect of four levels of dried distillers grains (DDG) substituting for corn-soybean meal on growth of sheep, 32 Pelibuey ram lambs (BW= 19.0 kg) were fed for 84 d in a randomized block experiment. The animals were weighed and blocked by weight in 16 groups of two, placed into 16 (2 x 3 m) floor pens, and assigned to one of 4 diets: 1) Control had 17.3% CP and 3.48 Mcal DE/kg, and contained 12.5% corn straw, 62% whole corn grain, 15% soybean meal, 8% sugarcane molasses, and 2.5% mineral premix; 2) like Control, DDG15 had 17.3% CP and 3.50 Mcal of DE/kg, but contained 15% DDG, 56% whole corn grain, and 6% soybean meal; 3) like Control, DDG25 had 17.3% CP and 3.53 Mcal of DE/kg, but contained 25% DDG and 52% whole corn grain; and 4) like Control, DDG35 had 18.4% CP and 3.53 Mcal DE/kg, but contained 35% DDG and 42% whole corn grain. Feed was offered twice daily under free access conditions. In the first 28 d of the experiment, diet had no effect on ADG (245, 240, 244, 202 g/day), DMI (865, 821, 838, 828 g/day), or feed/gain (3.55, 3.52, 3.46, 4.14) for Control, DDG15, DDG25, and DDG35, respectively. Also, for the entire 84-d period, ADG (224, 217, 199, 184 g/d), final weight (38.6, 38.2, 36.4, 36.4 kg), and feed/gain (4.17, 4.54, 4.79 4.82) were similar ($P > 0.05$) for Control, DDG15, DDG25, and DDG35 diets, respectively. It is concluded, that DDG can substitute for a mix of whole corn grain and soybean meal in diets for Pelibuey sheep.

Key Words: Dried Distillers Grains, Soybean Meal, Pelibuey Sheep

W343 Effect of dried distillers grains substituting for corn-soybean meal on apparent digestibility and energy concentration of feed in growing Pelibuey sheep. A. Estrada-Angulo*[1], G. Contreras[1], M. Osuna[1], A. Perez[1], O. Lozano[2], and E. Vazquez[1], [1]*FMVZ - UAS*, *Culiacán, Sinaloa, Mexico*, [2]*Ganadera Flexi*, *Culiacán, Sinaloa, Mexico*.

To determine the effect of four levels of dried distillers grains (DDG) substituting for corn-soybean meal on apparent digestibility in sheep, four male Pelibuey sheep (15.0 kg) were used in a 4 × 4 Latin square with the following diets: 1) Control had 17.3% CP and 3.48 Mcal DE/kg, and contained 12.5% corn straw, 62% whole corn grain, 15% soybean meal, 8% sugarcane molasses, and 2.5% mineral premix; 2) like Control, DDG15 had 17.3% CP and 3.50 Mcal of DE/kg, but contained 15% DDG, 56% whole corn grain, and 6% soybean meal; 3) like Control, DDG25 had 17.3% of CP and 3.53 Mcal of DE/kg, but contained 25% DDG and 52% whole corn grain; and 4) like Control, DDG35 had 18.4% of CP and 3.53 Mcal of DE/kg, but contained 35% DDG and 42% whole corn grain. The DM excreted in feces was higher ($P = 0.01$) for DDG35 (88.8 g/d) compared to Control, DDG15, and DDG25 (66.1, 75.3, and 76.1 g/d, respectively). The apparent digestibility of DM for Control, DDG15 and DDG25 (84.8, 82.7, 82.4, respectively) was better than for DDG35 (79.8%, $P = 0.10$). The DE concentration was lower ($P = 0.01$) for DDG35 (3.42 Mcal/kg of DM) than for Control, DDG15, and DDG25 (3.64, 3.54, and 3.53, respectively). The observed/calculated DE ratio was lower for DDG35 (0.97) while it was higher or equal (1.05, 1.01, and 1.0) for Control, DDG15, and DDG25, respectively. It is concluded that a whole corn grain-soybean meal mixture can be substituted with DDG at 15 or 25% of the diet without an effect on apparent digestibility of DM and energy concentration, but the inclusion of 35% of DDG reduces the apparent digestibility of DM and DE concentration in diets for growing Pelibuey sheep.

Key Words: Dry Distillers Grains, Apparent Digestibility, Pelibuey Sheep

W344 Quantitative carcass characteristics of different sheep categories. R. S. B. Pinheiro, A. G. Silva Sobrinho, R. M. S. Emediato*, and S. M. Yamamoto, *São Paulo State University*, *Botucatu, São Paulo, Brazil*.

Thirty-six 1/2 Ile de France, 1/2 Polwarth sheep (12 ram lambs, 12 culled ewes and 12 culled wethers) were used to evaluate carcass quantitative characteristics of different sheep categories. Animals were grazed on Tifton-85 pasture and supplemented with concentrate. Lambs were weaned at 17 kg and slaughtered at 32 kg of live weight, at around 5 mo of age. Ewes and wethers were slaughtered at 55 kg and 60 mo of age. Sheep categories did not affect dressing percentages of hot or cold carcass, but chilling losses were higher in carcasses from young (3.67%) than adult animals (2.35%). The percentages of leg, rib and shoulder cuts did not differ among animal categories, but neck percentages were higher in wethers (9.29%) and loin percentages were higher in lambs (14.56%). In conclusion, sheep categories influenced carcas chilling losses, without alterations on carcass yield.

Key Words: Carcass Yield, Dressing Percentage, Sexual Condition

W345 Measurements of *Longissimus dorsi* muscle cross-section and leg muscularity index of sheep from different categories. R. S. B. Pinheiro, A. G. Silva Sobrinho, A. M. Jorge, R. M. S. Emediato*, and S. M. Yamamoto, *São Paulo State University*, *Botucatu, São Paulo, Brazil*.

The objective of this experiment was to compare measurements of *Longissimus dorsi* muscle cross section at the 13th rib, fat depth, and leg muscularity index of different categories of sheep. Thirty-six 1/2 Ile de France 1/2 Polwarth animals (12 ram lambs, 12 culled ewes and 12 culled wethers) were used. Animals were raised on Tifton-85 pasture and were supplemented with concentrates. Lambs were weaned at 17 kg and slaughtered at 32 kg live weight, at about 5 mo old. Ewes and wethers were slaughtered at 55 kg and about 60 mo of age. Measurements of *Longissimus dorsi* muscle cross section were different among all animal categories, except for the maximum linear dimension of the muscle cross section, with an average value of 5.4 cm. Maximum depth of muscle was higher for adult animals (3.4 cm) than lambs (3.0 cm); consequently, the loin eye area of lambs was also smaller than for adult ewes and wethers. Maximum fat thickness of wethers was 2.6 cm. This was higher than for ewes (1.9 cm) and lambs (0.8 cm). Leg muscularity index was different among animal categories, with higher values (0.46) for adults (ewes and wethers) and lower values (0.40) for lambs. In conclusion, sheep categories affected measurements of *Longissimus dorsi* muscle cross-section and leg muscularity index.

Key Words: Carcass, Sheep, Muscle

W346 Yield of wholesale cuts and non-carcass components of Morada Nova and Somális Brasileira × Morada Nova ram lambs. R. S. B. Pinheiro[1], A. G. Silva Sobrinho[1], A. M. Jorge[1], R. M. S. Emediato*[1], S. Gonzaga Neto[2], and S. M. Yamamoto[1], [1]*São Paulo State University*, *Botucatu, São Paulo, Brazil*, [2]*Paraíba Federal University*, *Areia, Paraíba, Brazil*.

The objective of this experiment was to evaluate carcass cut percentages and non-carcass component yields of Morada Nova and Somális Brasileira × Morada Nova lambs grown in a feedlot. Lambs were fed a diet containing 40:60 forage:concentrate ratio. Sixteen ram lambs averaging 15 kg initial BW were included in each genetic group. Morada Nova lambs had higher percentages of neck (9.7%) and loin (13.3%) cuts than crossbred lambs (8.0 and 10.4%, respectively). Leg and rib cut yields were higher for crossbred lambs (35.1 and 27.0%, respectively) than Morada Nova lambs (32.7 and 25.0%, respectively). There was no breed effect for shoulder blade percentage, which averaged 19.4%. Except for the liver and tongue, with no breed effect and average values of 2.29% and 0.35%, respectively, non-carcass component percentages were influenced by breed. Crossbred lambs had higher percentages of skin (8.96), head plus foot (10.68), heart (0.88), and kidney (0.93) than purebred lambs (7.15, 9.69, 0.56 and 0.35, respectively). In conclusion, Somális Brasileira × Morada Nova lambs had different percentages of carcass cuts as well as non-carcass components compared with Morada Nova lambs.

Key Words: Commercial Cuts, Crossbreeding, Sheep

W347 Effect of rumen-protected fat in diets of Bergamasca ewes on lamb growth, ewe weight gain, and milk production. M. M. Stradiotto, E. R. Siqueira, R. M. S. Emediato*, S. A. Maestá, and A. Piccinin, *São Paulo State University*, *Botucatu, São Paulo, Brazil*.

The amount and quality of milk may be reduced if the ewe diet is improperly balanced. At the beginning of their development, lambs rely almost uniquely on ewe milk. If the ewe diet limits milk production, lamb development is limited, with low weight at weaning. The objective of this project was to determine the effect of rumen-protected fat on milk production and weight gain of Bergamasca milk ewes and their lambs. The experiment was carried out at the Ewe Milk Production Research Unit of the School of Veterinary Medicine and Animal Science of the São Paulo State University (UNESP), with 80 Bergamasca ewes allocated at random to one of two diets: 1) a concentrate and corn silage diet; and 2) diet 1 with rumen-protected fat added to the concentrate at 35 g/ewe per d starting 20 d prior to lambing. In both groups, lambs were kept with their dams on pasture during the day and separated at night. After the morning milking, lambs were returned to their mothers. Lambs were weaned at 45 d of age. Ewes were mechanically milked for 60 d. Ewe and lamb ADG, milk protein, milk fat, milk lactose, and total milk solids were analyzed by t-tests. Added fat did not influence ($P > 0.05$) lamb birth weight, weight weaning, or ewe or lamb ADG. Adding protected dietary fat to the diet of lactating ewes did not affect lamb growth or ewe milk production or weight gain.

Key Words: Energy, Weight Gain, Sheep Milk

W348 Effect of weaning system on composition and yield of milk of Bergamasca ewes. L. S. Serrão, E. R. Siqueira, R. M. S. Emediato*, E. O. Queiroz, C. C. Boucinhas, M. M. Stradiotto, and S. A. Maestá, *São Paulo State University*, *Botucatu, São Paulo, Brazil*.

The objective of this experiment was to study the effects of three weaning systems on milk production and composition and somatic cell count (SCC) of Bergamasca ewes. Prior to parturition ewes were allocated to one of the following three treatments: 1) ewes weaned from their lambs at 48 h postpartum, and their lambs raised artificially (D1); or 2) beginning 48 h postpartum, ewes separated from their lambs for 17 h during the evening, ewes machine milked once daily in the morning, lambs allowed to suckle for 7 h during the day; lambs weaned at 45 d of age (MIX); or 3) ewes not machine milked and exclusively suckled by their lambs during first 30 d and then lambs were weaned (DY30). During the 90 d of the trial, ewes in all treatments were milked once a day after weaning of their lambs. Milk yield was recorded daily and samples of milk were collected weekly for milk composition analysis. Differences among weaning systems for milk yield and milk fat percentage were significant while ewes were nursing their lambs, and final average milk production was higher for D1 followed by MIX and D30, with 0.400, 0.351 and 0.293 kg/ewe per day, respectively. Although the experimental period was 90 d, D1 had a longer lactation (84 d) than D30 and MIX (71 and 70 d, respectively). No difference ($P > 0.05$) was observed for SCC (249, 164 and 188 x 10^3 cells/mL for D1, MIX and D30, respectively) or milk protein percentage, but higher milk fat percentage was observed for D1 (5.24%) and D30 (5.00%) than MIX (3.55%). The weaning system can be an important variable when the objective of the herd is intensive milk production. The D1 system will result in higher milk yield while the MIX system will result in a lower milk fat percentage as long as the lambs are nursing. This lower fat percentage could have a detrimental effect for cheese manufacturing.

Key Words: Dairy Ewe, Milk Constituents, Sheep Milk

W349 Effect of use of bypass fat in the feeding of Bergamasca milk ewes on gastrointestinal nematode infections. M. M. Stradiotto, E. R. Siqueira, R. M. S. Emediato*, A. F. T. Amarante, S. A. Maestá, and A. Piccinin, *São Paulo State University*, *Botucatu, São Paulo, Brazil*.

The goal of this trial was to evaluate the effect of bypass fat added to ewe diets on gastrointestinal nematode infections. The experiment was carried out at the Ewe Milk Production Research Unit of the School of Veterinary Medicine and Animal Science of the São Paulo State University (UNESP). Eighty Bergamasca ewes were submitted to two feeding systems. The randomized block experimental included two treatments: 1 – balanced diet (concentrate + corn silage) and 2 – same diet as 1 however with bypass fat (35 g/ewe per d) added to the concentrate. In both groups, lambs were kept with their mothers on pasture during the day, being separated at night. After morning milking, lambs were returned to their mothers, being weaned at 45 days of age. Ewes from both groups were mechanically milked for 60 days. Every fourteen days, blood samples and feces were collected to determine packed cell volume (PCV), total plasma protein levels (TPP), peripheral eosinophil counts, fecal nematode egg counts (FEC) and worm cultures. Data were analyzed by one-way analysis of variance,

with statistical significance between treatment means determined at $P < 0.05$. There was no effect of diet on any variable studied. *Haemonchus* spp, followed by *Trichostrongylus* spp were the predominant nematodes in the worm cultures. Protected fat added to diets of dairy ewes did not affect gastrointestinal nematode infections.

Key Words: Energy, Gastrointestinal Nematodes, Lactation

W350 Sheep mastitis: Pathogens and susceptibility to antimicrobial agents. L. S. Serrão, E. R. Siqueira, R. M. S. Emediato*, P. F. Domingues, E. O. Queiroz, C. C. Boucinhas, M. M. Stradiotto, and S. A. Maestá, *São Paulo State University*, *Botucatu, São Paulo, Brazil*.

A total of 655 samples of Bergamasca ewe milk were examined for subclinical mastitis by the California Mastitis Test and assigned scores of 1+, 2+ and 3+. The same samples were examined by bacteriological culture on blood agar and MacConkey agar. The isolated microorganisms were identified by Gram stain and taxonomy tests. Soon afterward, each microorganism was tested for in vitro antibacterial susceptibility. In total 49 microorganisms were isolated in pure culture distributed as follows: *Staphylococcus* sp (n=39; 79.6%), *Streptococcus* sp (n=4; 8.16%), *Mannheimia haemolytica* (n=2; 4.1%), *Bacillus* sp (n=2; 4.1%), *Corynebacterium* sp (n=1; 2.05%), and *Escherichia coli* (n=1; 2.05%). In antibiotic susceptibility tests for *Staphylococcus* sp and *Streptococcus* sp, the agents isolated with highest frequency, florfenicol, gentamicin and cefalexin were the drugs of best efficacy.

Key Words: Mastitis, Microorganism, Antibiotics

W351 Postpartum ovarian activity of Santa Ines lactating ewes fed soybean hulls replacing coastcross hay. R. C. Araujo[1], A. V. Pires*[1], I. Susin[1], C. Q. Mendes[1], G. H. Rodrigues[1], F. S. Urano[1], C. A. Oliveira[2], and P. Viau[2], [1]*ESALQ/University of São Paulo*, *Piracicaba, SP, Brazil*, [2]*FMVZ/University of São Paulo*, *São Paulo, SP, Brazil*.

Available data about the duration of anestrus postpartum of Santa Ines ewes are scarce. The objective of this experiment was to evaluate the effects of replacing coastcross hay NDF with soybean hull (SH) NDF on postpartum ovarian activity measured by progesterone (P_4) profiles. Fifty-six lactating ewes (initial BW 56.1 ± 6.8 kg) were penned individually and used in a complete randomized block design according to parity, type of rearing, offspring gender and lambing date. Hay NDF from a 70% roughage-based diet was replaced with SH NDF by 0 (SH0), 33 (SH33), 67 (SH67), and 100% (SH100), resulting in 0, 25, 54 and 85% of SH in the diet DM, respectively. Diets provided a similar NDF (56%) and CP (16%) content. BCS (1 to 5 scale) was assessed at the second and eighth week(weaning date) after lambing. Blood samples were collected by venipuncture twice a week, from the first to the twelfth week after lambing. Serum P_4 concentration was determined by RIA. Intra-assay and inter-assay coefficients of variation were 9.6% and 3.8%, respectively. The assay sensitivity was 96.1% for a minimal concentration of 0.01 ng/mL. Ovarian activity resumption was defined as six days prior to the date when P_4 concentration was ≥ 1 ng/mL. A linear increase ($P < 0.01$) for final BCS was observed with SH addition (3.09, 3.24, 3.34, and 3.36). Determined P_4 concentration ≥ 1 ng/mL and estimated mean ovarian activity resumption were 40.5 ± 15.6 and 34.5 ± 15.6 days after lambing, respectively, showing no difference ($P > 0.10$) among treatments. A quadratic effect ($P < 0.05$) was observed for NEFA concentration with values of 0.323, 0.244, 0.204, and 0.216 mEq/L for SH0, SH33, SH67, and SH100, respectively. Average ovarian activity resumption in Santa Ines ewes is attained earlier than two months postpartum.

Key Words: Hair sheep, Postpartum, Progesterone

W352 Multivariate analysis of within-litter birth weight variation, litter weight and litter size in the Ripollesa ewe. J. Casellas*, G. Caja, and J. Piedrafita, *Grup de Recerca en Remugants, Universitat Autònoma de Barcelona*, *Bellaterra, Spain*.

Birth weight plays a central role in lamb survival and growth, and the knowledge of its genetic determinism has become essential in worldwide selection programs. Within this context, within-litter birth weight variation (BWV) has been suggested as an attractive trait to homogenize litters in prolific species, although it has not been analyzed in sheep. The objective of this study was to ascertain whether maternal additive genetic variance exists for BWV in Ripollesa ewes, and to study its genetic, permanent and residual relationships with litter weight (LW) and litter size (LS) at birth. Data were recorded in the Ripollesa experimental flock of the Universitat Autònoma of Barcelona (Spain), between 1986 and 2005, and included 1,662 litters from 380 ewes, with 712 records of BWV and 1,530 records of LW. Traits were analyzed with a multivariate animal model solved through Bayesian methodologies, and with a threshold characterization of LS. Additive genetic variance was observed for BWV ($h^2 = 0.061$), as well as for LW ($h^2 = 0.200$) and LS ($h^2 = 0.141$). Nevertheless, genetic correlations among those traits were not substantial and suffered from a high degree of uncertainly, with the null correlation included within the highest posterior interval at 95%. Within-litter birth weight variation and LS showed a negative and large permanent environmental correlation (-0.872), and LW and LS were negatively correlated due to residual (-0.762) and permanent environmental (-0.449) random sources of variation. The low heritability found indicates that slow genetic progress may be expected from selecting for BWV. Close to zero genetic correlations suggest that this selection will probably not affect LS and LW, although some significant permanent and residual correlations must be taken into account. Further studies are needed to better understand the genetic architecture among these three reproductive traits.

Key Words: Birth Weight, Litter Size, Ripollesa Breed

W353 The influence of maternal and fetal breed on vascularity of the placenta in sheep. P. P. Borowicz*, A. T. Grazul-Bilska, D. A. Redmer, K. A. Vonnahme, J. S. Caton, and L. P. Reynolds, *Center for Nutrition and Pregnancy, and Department of Animal and Range Sciences, North Dakota State University*, *Fargo*.

The aim of the experiment was to determine the influence of fetal and maternal breeds on fetal placental (cotyledonary, **COT**), and maternal

placental (caruncular, **CAR**) vascularity in sheep. Previously we have reported the profound effect of maternal and fetal breed on placental and fetal weights (Borowicz et al., 2006). We hypothesized that the vascularity of placentas of highly prolific Romanov (**R**) sheep (litter-bearing, small birthweight) differs from that of Columbia (**C**) sheep (traditional, large birthweight). We also hypothesized that not only the maternal but also the fetal genome determines the size and vascularity of the placenta. Straight-bred (controls) and reciprocal pregnancies were established by transferring embryos from R or C ewes to R or C recipients (n = 1 embryo per dam; n = 4 to 11 total dams per group; groups: R×R, R×C, C×C, and C×R, where the first letter is the embryo breed and the second is the ewe breed). Gravid uteri were collected on d 130 of gestation and separate placentomes were fixed with Carnoy's solution by perfusion of the main arterial vessels supplying the CAR or COT, embedded in paraffin, sectioned, and stained, and vascularity was determined by image analysis (Image-Pro Plus) using 15 micrographs/placentome. For each CAR and COT, we determined: the capillary area density (**CAD**, total capillary area as a proportion of tissue area), capillary number density (**CND**, total number of capillaries per unit of tissue area), and capillary surface density (**CSD**, total capillary circumference per unit of tissue area). For CAR, CND and CSD were not different between fetal or maternal breeds. CAD was greater in the R dams regardless of the embryo breed ($P<0.05$). For COT, CND and CSD were greater in C×C and R×R vs. R×C ($P<0.06$). These data suggest minimal effects of fetal and maternal breed on placental vascularity in sheep with different prolificacies. Supported by *NIH grant HL64141 to LPR and DAR; and NIH grant P20 RR016741 from INBRE.*

Key Words: Placenta, Vascularity, Sheep

W354 Genetic resistance to nematode parasites in sheep: Use of Box-Cox transformation in QTL mapping. M. V. B. Silva*[1], C. P. Van Tassell[1], T. S. Sonstegard[1], J. Mugambi[2], S. Nagda[2], S. McClintock[2], M. Malek[3], P. Boettcher[3], S. Kemp[2], J. F. Garcia[3], F. Iraq[2], and O. Hanotte[2], [1]*United States Department of Agriculture, Agricultural Research Service*, *Beltsville,MD*, [2]*International Livestock Research Institute*, *Nairobi, Kenya*, [3]*Atomic Energy Agency*, *Vienna, Austria*.

Fecal egg count (FEC) is used to quantify gastrointestinal parasite infestations. However, FEC values are not distributed normally, and a small percentage of the herd is often responsible for a majority of parasite transmission. Non-normality is a possible source of error when (co)variance components and genetic parameters are estimated, as well as decreasing likelihood of quantitative trait loci (QTL) detection. Typically, the distribution of FEC is right-skewed with a long tail and a high frequency of zero values (zero-inflated distribution). Nearly all QTL studies to date have used logarithmic transformations of FEC data before QTL analysis. In our study, six first cross (F1) Red Maasai x Dorper rams were mated to both Red Maasai (R) and Dorper (D) ewes to produce 1342 reciprocal backcross progeny. These six resource families were used to identify QTL controlling resistance to gastro-intestinal (GI) nematode parasites (particularly Haemonchus contortus). FEC measures were determined for 361 animals from 1 to 6 months old. In this study, original data were transformed using an extension of the Box-Cox transformation to approach normality and to estimate the position and variance components of the QTL in 19 of the 26 ovine autosomes. QTL detection was done using QxPak. Transformation of ovine FEC data utilizing the Box-Cox were effective in reducing the coefficients of asymmetry and kurtosis for the variable studied, which improved estimates of variance components of the QTL. Significant QTL for FEC were detected in chromosomes 7, 8, 9, 13, 14, 15, 16, 22, and 23. These results indicate that after transforming data by the Box-Cox procedure the genetic parameters in relation to QTL were more exact.

Key Words: QTL, Parasites, Sheep

W355 Effect of HCl-Zilpaterol and HCl-ractopamine on non-carcass components of hair sheep grown in the feedlot. F. G. Rios*, J. C. Robles, A. Estrada-Angulo, J. F. Obregon, G. Contreras, and A. B. Perez, *FMVZ - UAS*, *Culiacan, Sinaloa, Mexico*.

To determinate the effects of beta-agonists clorhidrate of zilpaterol (HCL-Z) and clorhidrate of ractopamine (HCL-R) on non-carcass components of hair sheep grown in the feedlot, 60 ram lambs (35.81 ± 3.05 kg initial weight) were used in a randomized complete block experiment where block was initial weight. The lambs were assigned to one of three diets fed ad libitum: 1) control diet with 17% CP and 3.62 Mcal of DE/kg consisting of 11.9% Sudan grass hay, 62% whole corn grain, 14% soybean meal, 2.0% meat meal, 5.0% cane molasses, 2.0% animal fat, 2.5% mineral premix and 0.6% sodium bicarbonate; 2) diet similar to control but with the addition of 15.5 ppm of HCL-R; and 3) diet similar to control but with addition of 3.75 ppm of HCL-R. Hot carcass (HCW), full gut (FGW), empty gut (EGW), and mesenteric fat weights (MFW) were recorded. The data were analyzed by one-way ANOVA with the 2 df for diet fitted as orthogonal contrasts comparing: 1) control with the average of HCL-Z and HCL-R; and 2) HCL-Z with HCL-R. The hot carcass weight was increased 5.54% ($P < 0.05$) for lambs fed diets with beta agonists, but the dressing percentage was improved 1.31% only for lambs fed the diet with HCl-Z compared with lambs fed the diet with HCl-R. Diets with beta agonists increased ($P < 0.05$) empty body weight (38.98 vs. 37.71 kg; 0.78 SEM) and EGW (3.16 vs. 2.82 kg; 0.076 SEM). A similar effect ($P < 0.05$) was observed for the percentage of empty gut weight (7.45 vs. 6.89% of HCW; 0.10 SEM), but there was no effect for FGW, which averaged 6.77 kg and 16.04% of HCW. MFW averaged 819 g and was not affected by diets. These data show that addition of HCl-Z and HCl-R to diets of hair sheep increased hot carcass, empty body, and empty gut weights.

Financial support by PROFAPI-UAS 2006

Key Words: B-agonist, Empty Body Weight, Hair Sheep

W356 Nutritional value of sticky coffee hull silage on starting pigs diets. I. Moreira*[1], P. L. O. Carvalho[1], D. Paiano[2], L. M. Peñuela Sierra[3], L. M. Piano[1], and M. E. O. Girola[1], [1]*Universidade Estadual de Maringá*, *Maringá, Paraná, Brazil*, [2]*Universidade Estadual de Mato Grosso do Sul*, *Aquidauana, MS, Brazil*, [3]*Universidad Del Tolima*, *Ibagué, Tolima, Colombia*.

These experiments were conduct to study the use of sticky coffee hull (SCH) silage (SCHS) on starting pigs feeding. SCH (caffeine = 0.59%; tannin = 0.82%, as-fed-basis) is a by-product obtained from coffee processing (conversion the raw fruit of the coffee plant (cherry) into the commodity green coffee) and may represent an environmental threat. In Brazil there is a great supply of this cheap by-product. SCH was ground (4 mm screen-opening diameters) before ensilaging. There were at least 30 days of ensilage period before using it. Chemical composition (as-fed-basis) of SCHS is: DM= 66.48%; CP= 6.79%; GE= 2,753 kcal/kg; CF= 10.48%; ADF= 15.97%; NDF= 19.23%; hemicelulose= 3.26%; lignin= 3.77 %; ash= 4.587%; Ca= 0.20 %; P= 0.07%. Experiment I consisted of a digestibility trial using 15 piglets (Initial BW= 20.78±2.86 kg). In the Experiment II, 60 piglets (BW = 15.52±2.19 to 32.52±3.51 kg) were used in a performance study. Piglets were allotted to treatments with six replicates of two pigs per replicate in a randomized complete block design. Treatments consisted of a corn-soybean meal basal diet (0%) and four diets with sticky coffee hull (4, 8, 12, and 16%). Experimental diets were formulated to meet the same nutrients levels (NRC, 1998). From Experiment I it was obtained: Digestibility coefficient of energy of SCHS= 57.49%, which means 1,583 kcal of DE/kg (as-fed-basis). Performance data (Experiment II) were, respectively for 0, 4, 8, 12 and 16 % of SCHS inclusion: DFI = 1.345, 1.359, 1.304, 1.222 and 1.264 kg; DWG = 0.665, 0.671, 0.643, 0.592 and 0.640 kg; F: G ratio: 2.027, 2.031, 2.028, 2.056 and 1.976. The regression analysis indicates no effects (P≥0.05) of sticky coffee hull silage inclusion on piglet performance (DFI, DWG and F: G ratio). The results indicated 1,583 kcal of DE/kg of SCHS and suggest that it is feasible to use up to 16% of sticky coffee hull silage on starting piglet diet.

Financial support: CNPq (Brazil).

Key Words: By-Product, Ddigestibility, Performance

W357 Use of sticky coffee hull silage on growing pigs feeding. I. Moreira*[1], P. L. O. Carvalho[1], D. Paiano[2], G. C. Oliveira[1], I. S. Kuroda Júnior[1], and F. L. Mourinho[1], [1]*Universidade Estadual de Maringá*, *Maringá, Paraná, Brazil*, [2]*Universidade Estadual de Mato Grosso do Sul*, *Aquidauana, Mato Grosso do Sul, Brazil*.

Two experiments were carried out to evaluate nutritional value of sticky coffee hull (SCH) silage (SCHS) on growing pigs feeding. SCH (caffeine = 0.59%; tannin = 0.82%, as-fed-basis) is a by-product obtained from coffee processing (conversion the raw fruit of the coffee plant (cherry) into the commodity green coffee) and may represent an environmental threat. In Brazil there is a great supply of this cheap by-product. SCH was ground (4 mm screen-opening diameters) before ensilaging. There were at least 30 days of ensilage period before using it. Chemical composition (as-fed-basis) of SCHS is: DM= 63.71%; CP= 6.56%; GE= 2,708 kcal/kg; CF= 10.14%; ADF= 15.55%; NDF= 18.62%; hemicelulose= 3.07%; lignin= 3.64%; ash= 4.37%; Ca= 0.20%; P= 0.07%. Experiment I consisted of a digestibility trial using 15 pigs (Initial BW= 43.09±4.12 kg). In the Experiment II, 60 pigs (BW = 32.52±3.21 to 59.58±4.01 kg) were used in a performance study. Pigs were allotted to treatments with six replicates of two pigs per replicate in a randomized complete block design. Treatments consisted of a corn-soybean meal basal diet (0%) and four diets with sticky coffee hull (4, 8, 12, and 16%). Experimental diets were formulated to achieve the same nutrients levels (NRC, 1998). From Experiment I it was obtained: Digestibility coefficient of energy of SCHS = 49.87%, which means 1,351 kcal of DE/kg (as-fed-basis). Performance data (Experiment II) were, respectively for 0, 4, 8, 12 and 16% of SCHS inclusion: DFI = 1.919, 1.834, 1.831, 1.742 and 1.703 kg; DWG = 0.823, 0.744, 0.775, 0.764 and 0.738 kg; F: G ratio: 2.340, 2.456, 2.361, 2.274 and 2.312. No effects (P≥0.05) of sticky coffee hull silage inclusion on piglet performance (DFI, DWG and F: G ratio) were showed by regression analysis. It can be concluded that using up to 16% of sticky coffee hull silage (1,351 kcal of DE/kg) on growing piglet diet is feasible.

Financial support: CNPq (Brazil)

Key Words: By-Product, Digestibility, Performance

W358 Evaluating varied periods of water deprivation on body weight and feed intake in 50 to 70 kg pigs. A. D. Quant*, M. D. Lindemann, G. L. Cromwell, H. J. Monegue, J. S. Monegue, and B. G. Kim, *University of Kentucky*, *Lexington*.

Water deprivation can occur in swine production for various reasons (e.g., transport, water line breakage or freeze, power outage, etc.). A study was conducted to examine short and long-term effects of various water deprivation periods on pig performance. Crossbred pigs (n = 80; initial BW: 59.07 ± 3.93 kg) were blocked by gender and BW and allotted to 5 treatments with 4 replications of 4 pigs/pen. Pigs were weighed and observed twice daily for 5 d during and following the period of deprivation (0, 10, 13, 24, and 48 h deprivation), then weighed weekly for 7 wk. Minimum and maximum ambient temperatures during deprivation were 20.51 and 22.25°C. Pigs were allowed ad libitum access to water (except during deprivation) and feed for the entire experimental period. Backfat depth and longissimus muscle depth were measured by ultrasonography at the conclusion of the experiment. As duration of water deprivation increased, BW loss during deprivation increased (0.00, 1.22, 1.85, 2.56, and 4.06 kg) linearly ($P < 0.01$) and quadratically ($P < 0.01$). Body weight gain in the first 24 h immediately following water restoration increased (0.88, 2.41, 2.93, 4.01, and 5.74 kg) linearly ($P < 0.01$) and quadratically ($P < 0.05$) as water deprivation increased. Feed intake 24 h post deprivation was not affected by treatment (2.76, 2.74, 2.74, 2.72, and 2.93 kg; $P = 0.73$). During the 5-d observation period, BW gain decreased linearly (4.49, 3.89, 3.72, 3.52, and 2.95 kg; $P < 0.01$) as deprivation time increased, but 7-wk BW gain was not affected by treatment (49.66, 49.89, 50.37, 49.46, and 51.85 kg; $P = 0.61$). The length of water deprivation had no effect on backfat depth (17.44, 17.94, 16.38, 17.31, and 18.69 mm; $P = 0.59$) or longissimus muscle depth (56.63, 60.81, 59.25, 58.06, and 58.44 mm; $P = 0.73$). Therefore, based on growth performance and carcass characteristics, we conclude that water deprivation in grower pigs for durations less than 48 h

results in no detrimental effects to the pigs. The BW changes associated with the period of deprivation would seem to be largely those of dehydration, rehydration, and gut fill.

Key Words: Pigs, Water Deprivation

W359 Evaluation of pigs raised on two types of pasture-based and a confined grow-finish systems for production efficiency. K. Nadarajah*, D. L. Kuhlers, and W. F. Owsley, *Auburn University*, *Auburn, AL*.

Two independent grow-finish (G-F) trials with 2 pasture-based stocking systems (rotational (RP) and continuous (CP)) along with a confined (CF) system each with 2 replicates were conducted in spring and fall of 2004, to evaluate production efficiency of pigs. Each pasture based G-F stocking system utilized 0.2 hectares of electrical fenced plot with shade, and feed and water available *ad libitum*. In the CP system, pigs for a replicate had access to entire 0.2 hectares; however, a replicate for pigs in the RP system had access to one-fourth of the 0.2 hectares paddock, and remained in it for 2 wk and were rotated to next sub paddock. Each pen in the CF was about 12.5 m^2. A replicate is the experimental unit that consisted of 8 feeder pigs for a total of 48 pigs/trial. Pigs were evaluated for growth rate, feed efficiency, hot carcass wt and incidence of parasitic infestation (liver scores 1- 6: <10 spots with incremental increase of 10, where 6 =>50 spots; lungs scores 0-5: no damage with increasing increments of 20%, where 5 => 80% damage). Growth performance data of pigs (off test wt, ADG, and hot carcass wt) were analyzed using a mixed model fitting the effects of covariate for initial entry wt and trial, system, sex and their interactions as fixed effects and replicate nested within trial and system as a random effect. Differences ($P < 0.05$) for trial, system and sex were observed for all growth performance traits. Initial entry wt influenced off test wt and hot carcass wt ($P < 0.001$). Compared to RP and CP systems, pigs from CF systems grew faster (ADG: 0.67 and 0.66 vs. 0.78 kg; $P = 0.06$), and were heavier at off test (108 and 107 vs. 122 kg; $P = 0.02$) and for hot carcass wt (81 and 81 vs. 93 kg; $P = 0.02$).There was no difference in growth rate of pigs between the RP and CP systems. Difference between trials for growth performance may have been due to effect of season. Pen G:F for pigs in the CF system was more efficient than RP and CP systems (0.30 vs. 0.26 and 0.28; $P < 0.05$). Liver and lung scores did not differ between trials or systems. Pigs on sustainable outdoor pasture environments were equally healthy as in CF.

Key Words: Pigs, Pasture, Growth

W360 An analysis of the effect of age and weaning status on gastrointestinal characteristics and microbiota of young pigs. J. C. Miguel*, P. J. Laski, R. I. Mackie, and J. E. Pettigrew, *University of Illinois*, *Urbana*.

A 3 wk experiment was conducted to evaluate the effect of age and weaning status on gastrointestinal characteristics and microbiota of young pigs. Thirty pigs were weaned at 21.2 d of age and 5.95 kg BW and allotted to one of three euthanasia dates. Six pigs were euthanized at weaning and the remaining 24 pigs were separated into two groups of 12 pigs and euthanized on d 7 or 21 post-wean. At euthanasia, tissue segments were taken from the small intestine for morphology. The stomach, small intestine, cecum, and large intestine were emptied and wet weights recorded. Luminal contents and mucosal scrapings from the pars esophagea, fundus, jejunum, ileum, proximal colon, and distal colon were collected for genomic DNA isolation. The variable 3 (V3) region of 16S rDNA was amplified by PCR and denaturing gradient gel electrophoresis (DGGE) was utilized to generate microbial profiles. Bands generated following PCR-DGGE were enumerated and Sorenson′s pairwise similarity coefficients (C_s) were analyzed. Pigs at 7 d post-wean had reduced ($P < 0.05$) villus height in the duodenum and ileum and a smaller ($P < 0.05$) villus height:crypt depth and villus cross-sectional area in all 3 segments. Pigs at wean had a smaller ($P < 0.05$) crypt depth in all 3 segments. As the pigs aged, there was an increase ($P < 0.01$) in digestive organ weight as a percent of body weight. Analysis of PCR-DGGE band numbers indicated differences ($P < 0.05$) among age groups but no consistent pattern according to age or weaning status. Pigs at wean had more bands in jejunal luminal contents and mucosa and fewer band numbers in distal colonic luminal contents compared to pigs at 7 and 21 d post-wean. Comparisons of microbial diversity indicated similarity among pigs within age groups was greater ($P < 0.05$) than between age groups ($P < 0.05$), signifying age-dependent alterations in microbial banding patterns. Age and weaning status appear to influence the gastrointestinal environment of young pigs.

Key Words: Pigs, GastrointesFinal, 16S rDNA PCR-DGGE

W361 Effect of bacitracin supplementation on lactation management, neonatal piglet performance, and subsequent reproductive performance of sows. F. B. Turner*[1], L. M. Thompson[1], K. J. Kinney[1], S. E. Shute[1], W. L. Flowers[1], R. A. Schlutz[2], and B. Pratte[3], [1]*North Carolina State University*, *Raleigh*, [2]*Avoca Veterinary Clinic*, *Avoca, IA*, [3]*Alpharma Animal Health Division*, *Fort Lee, NJ*.

A study was conducted to examine the effect of supplementation of bacitracin in sow diets on lactation management and neonatal growth and mortality of piglets on a 2400-head commercial sow farm with a yearly average of 24 pigs per sows per year. There were no clinical signs of clostridial enteritis at the onset of the study. Females were housed in pens of 8 to 10 animals during gestation and moved into individual farrowing crates by day 112 of gestation. Sows (n=130 per treatment) were randomly assigned to receive feed supplemented with either 0 or 250 grams of BMD®/ton from day 100 of gestation through weaning. Piglets (n= 2767) received ear tags and were weighed within 2 days of birth and at weaning. Weaning age decisions were made by farm personnel independent of the study. Fecal samples from a subset of sows (n=30 per treatment) indicated that BMD® significantly reduced ($P < 0.05$) the clostridial load. No differences ($P > 0.30$) were observed in neonatal mortality or piglet weight within 2 days of birth. The proportion of litters in which piglets were crossfostered during lactation was lower ($P < 0.05$) in BMD® than control sows. Crossfostering tended to reduce ($P < 0.08$) the growth of piglets in a litter independent of treatment. There was no difference ($P > 0.12$) in unadjusted weaning weights of piglets between treatments. However, piglets nursing sows receiving BMD® were weaned an average of 2.3 days earlier ($P < 0.05$) than piglets nursing control sows which resulted in a higher ($P < 0.05$) weight per day of age during lactation. This was particularly evident for piglets whose weight at 2 days of age was less than 1.3 kg. Subsequent reproductive performance of sows was not affected by treatment ($P > 0.25$). In summary, supplementation of

gestation and lactation diets with bacitracin decreased the need for crossfostering and improved neonatal growth of piglets.

Key Words: Bacitracin, Lactation, Swine

W362 Comparing histopathological scores and exterior data for phenotyping pigs to address leg weakness. C. Rudolph, E. Tholen, M. Mielenz, G. Breves*, K. Schellander, and H. Sauerwein, *University of Bonn*, *Bonn, Germany*.

Leg weakness is one of the most serious problems in the pig industry. Herein we aimed to establish a classification modus from a histological evaluation of four joint cartilage surfaces in pigs and to relate the findings to exterior data. From 139 pigs of a F2 crossing of pietrain (Pi) x Duroc (Du) and Du × Pi, the stance in angle and position of fore- and hind legs was assessed and linearly scored (1 to 5, 3 is optimal). After slaughter, femur and humerus were dissected, each the distal and the proximal ends were cut into longitudinal slabs and histological sections were prepared from the joint surfaces. Two sections per joint surface were microscopically evaluated whereby the following criteria were recorded and then classified: Score 1: no pathohistological alterations, only marginally rough surface or weakly eosinophilic matrix or fibrillation; score 2: marginal histophathological alterations comprising fibrillation and hyperplasia and minor vascularization of the joint cartilage; score 3: severe alterations of the surface structures and the deeper layers; score 4: massive alterations of the cartilage including necrotic or ossified areas. All joints were accordingly scored and summarized for each animal. Data of exterior and histology were linked by the procedure FREQ of the SAS programme. According to their exterior data, only 12.2% of the pigs had consistently optimal scorings. By histology, no animal was without any aberrations; 15.5% of the animals had large-scale changes on each of the joints assessed. Significant ($p \leq 0.055$) analogies with medium contingency factors ($c = 0.23$ to 0.32) were found between individual exterior and histology data, e.g. between the exterior scores for hindleg stance and the histological scores from proximal and distal femur joint surface. Consideration of histological traits thus extends the repertoire available to characterize alterations associated with leg weakness and can therefore be used as an additional tool when aiming to comprehensively phenotype animals for genetic approaches.

Key Words: Pig, Leg Weakness, Histology

W363 A novel freezing-thawing device for porcine semen using a detachable catheter. G. Rocha-Chavez[1], M. A. Pinto-Jacobo*[2,1], L. Pinal-Suazo[1], and J. G. Michel-Parra[1], [1]*CUSUR Univ de Guadalajara*, *Cd Guzman Jalisco Mexico*, [2]*URPJ*, *Guadalajara Jalisco Mexico*.

Current freezing protocols for porcine semen require at least 2 billion spermatozoa packed in either several 0.5 cc straws, or one maxi straw of 5cc. Thawing protocols require the use of a minimum of 50 ml of extender for re-suspension of semen under a strictly controlled procedure. The objective of this study was to determine motility readings of thawed semen packed either in traditional .5 cc straws or in a novel separable intrauterine device. The sperm-rich fraction of three boars of known fertility was collected using the gloved hand technique. The semen was pooled, diluted 1:1 centrifuged (900g for 15 min) and the supernatant was resuspended in freezing extender and packed in either five straws of 0.5 cc (treatment 1) or two special maxi tubes (treatment 2). Maxi tubes are plastic tubes 37 cm long, 4 mm inside diameter and 0.7 mm wall thickness. For each treatment, a minimum of 2 billion spermatozoa per dose was used independently of the volume used for freezing. After gradual thawing, semen of treatment one was resuspended in a 27°C extender whereas semen on maxi tubes (treatment two) was thawed directly in a 27°C water bath and the two tubes were coupled using the pre designed steel connector. A special tip was connected in one end of the device and semen was forced out using isothermal extender at the other end. Semen was recovered in a prewarmed test tube and motility readings were made at 37°C using videorecording technology on both treatments. Ten replicates were made for each treatment and all readings were made in triplicate. Readings of 38 ± 7.3 and 42 ± 8.5 % on motility were found for treatment one and two respectively with no significant differences ($p<0.05$). It was concluded that after-thaw motility is the same for both treatments; however, the device can easily be used for direct deposition of semen at the uterine lumen of he sow using the right technique. Further in vivo studies are needed to validate the usefulness of the technique under field conditions.

Key Words: Frozen, Semen, Detachable

W364 Analysis of the association of factors associated with stillbirth in breeding sows. S. S. Anil*, L. Anil, J. Deen, S. K. Baidoo, and R. D. Walker, *University of Minnesota*, *St. Paul*.

The number of pigs weaned per litter and the number of pigs weaned per sow per year are adversely affected by a high stillborn rate and therefore it is important to analyze the risk factors associated with stillbirth in swine breeding herds. The objective of the present study was to analyze the association of the parity of the sow (categorized into ≤ 3 or ≥ 4), number of piglets born alive, number of mummies (0 or ≥ 1), litter birth weight, gestation length (categorized into ≤ 115 or ≥ 115 days) and farrowing induction (induced or not induced) with stillbirth (0 or ≥ 1) using logistic regression analysis (Proc logistic, SAS V 9.1). Data on 5290 parity records of sows were collected from the PigCHAMP database of the swine research unit of the University of Minnesota, Waseca, MN. Results indicated that the risk of having stillborn piglets was lower ($P \leq 0.05$) among sows of parity ≤ 3 compared to higher parity sows (Odds ratio, OR = 0.57). As litter birth weight increased the likelihood of having stillborn piglets decreased (OR 0.957, $P \leq 0.05$). Sows with no mummies were 29% less ($P \leq 0.05$) likely to have stillborn piglets. A higher number of piglets born alive and a gestation length of ≤ 115 days increased ($P \leq 0.05$) the risk of having stillborn piglets (OR 1.056 and 1.204 respectively). Sows that were not induced for farrowing had a higher ($P \leq 0.05$) risk of having stillborn piglets (OR 1.327). Results indicated that the factors associated with higher still births include, higher parity sows, sows that farrow in ≤ 115 days of gestation and sows that were not induced. These sows required special attention in order to minimize the risk of stillbirth.

Key Words: Stillbirth, Sows

W365 Influence of sex and terminal sire line on fresh meat quality, fatty acid profile of backfat, and ham weight losses during ripening of Iberian pigs reared under intensive production systems. M. P. Serrano[1], D. G. Valencia[1], R. Lázaro[1], A. Fuentetaja[2], and G. G. Mateos*[1], [1]*Universidad Politécnica de Madrid*, *Spain*, [2]*Copese*, *Segovia, Spain*.

Iberian (IB) pig is a native breed of Spain originally reared under free range conditions and sacrificed at 160 to 180 kg BW. Quality of cured products from IB pigs is high but productivity is low. During ripening of hams (15 d salting, 60 d postsalting, 31 d drying, and 639 d cellar phase), lipid changes occur and as a consequence the aroma and flavour of the products are improved. We studied the influence of sex (EF, gilts; CM, barrows) and terminal sire line (DD, Danish Duroc; SD, Spanish Duroc; RIB, Retinto Iberian) on fresh meat quality, fatty acid (FA) profile of backfat (BF), and ham weight losses during ripening in 180 pigs sacrificed at 145 kg BW. The female line used was pure RIB in all cases. Treatments were arranged factorially (2 x 3) with five replicates (six pigs) per treatment. Meat samples were taken at m. *Longissimus dorsi*. Samples of BF were taken at tail insertion from the two Duroc sire lines, but no samples were taken from the RIB sire line. Meat from CM had more lightness (42.1 vs. 40.0; $P < 0.05$) and more fat (8.6 vs. 6.1%; $P < 0.01$) but less protein (21.5 vs. 22.1%; $P < 0.01$) than meat from EF. No differences were detected between Duroc sire lines for any trait studied. Meat from RIB sired pigs was redder (11.3 vs. 7.8; $P < 0.001$) and had more intensive colour ($P < 0.01$) than meat from Duroc sired pigs. Also, meat from pure RIB pigs had more fat (8.8 vs. 6.8%; $P < 0.05$) and less protein (21.0 vs. 22.1%; $P < 0.001$) than meat from Duroc sired pigs. Treatment did not affect FA profile of BF. Weight losses during ripening were lower for CM than for EF (32.2 vs. 33.1%; $P < 0.01$) but were not affected by sire line. We conclude that entire females are an alternative to castrated females for production of Iberian pig and that Danish Duroc can be successfully used as sire line for this type of production.

Key Words: Iberian Pig, Duroc Pig, Quality

W366 Influence of gender on growth and carcass quality of pigs slaughtered at the same age destined to the production of high quality dry-cured hams. M. A. Latorre[1], L. Ariño[2], E. García[3], and R. Lázaro*[4], [1]*Centro de Investigación y Tecnología Agroalimentaria de Aragón*, *Zaragoza, Spain*, [2]*Integraciones Porcinas S.L.*, *Teruel, Spain*, [3]*Jamones y Embutidos Alto Mijares S.L.*, *Teruel, Spain*, [4]*Universidad Politécnica de Madrid*, *Spain*.

High quality dry-cured hams under the protection and designation of Teruel hams trademark are produced from heavy pigs in a specific area of Spain. For Teruel ham production the fat at Gluteus medius level should be at least 20 mm because lower fat levels impair the ripening process and ham quality. A total of 300 Landrace*Large White sows was crossed with Duroc boars. Forty hybrid pigs, with an average age of 182 d (50% castrated males with 110.1 kg BW and 50% entire females with 104.1 kg BW), were chosen at random. They were fed a commercial wheat, barley, and soybean meal diet containing 2,430 kcal NE/kg and 0.80% total lysine until slaughter age at 210 d. The effects of gender (castrates and females) on growth and carcass quality of pigs destined to the production of Teruel hams were studied. Each treatment was replicated twenty times (one pig per replicate). No effect of gender on average daily gain, carcass weight or dressing percentage was detected ($P > 0.05$). Castrates had more backfat (29.3 vs. 24.2 mm) and fat at Gluteus medius muscle (28.5 vs. 22.8 mm) than females ($P < 0.001$). In consequence, the percentage of carcasses with a Gluteus medius fat depth equal or greater than 20 mm was higher in castrates than in females (100 vs. 77.8%; $P < 0.05$). Gender did not influence carcass length nor pH or temperature at 45 min postmortem ($P > 0.05$). The weight of trimmed primal cuts (loins+shoulders+hams) was not affected by gender ($P > 0.05$), but the trimmed primal cut yield was higher in females than in castrates (46.9 vs. 44.5%; $P < 0.001$). It is concluded that castrated males are more adequate than entire females when sacrificed at the same age for the production of Teruel hams.

Key Words: Gender, Teruel Ham, Pigs

W367 Influence of slaughter weight on performance and carcass quality of pigs destined to the production of high quality dry-cured hams. M. A. Latorre[1], L. Ariño[2], E. García[3], and G. G. Mateos*[4], [1]*Centro de Investigación y Tecnología Agroalimentaria de Aragón*, *Zaragoza, Spain*, [2]*Integraciones Porcinas S.L. Teruel*, *Spain*, [3]*Jamones y Embutidos Alto Mijares S.L.*, *Teruel, Spain*, [4]*Universidad Politécnica de Madrid*, *Spain*.

High quality dry-cured hams under the designation of Teruel hams trademark are produced from heavy pigs in a specific area of Spain. For Teruel ham production the fat at Gluteus medius level should be at least 20 mm because lower fat levels impair the ripening process and ham quality. Two hundred (Landrace x Large White) × Duroc pigs, 50% castrated males and 50% entire females, with an average weight of 107 kg were used to study the effect of slaughter weight (SW; 120, 125, 130, 135 or 140 kg BW) on performance and carcass quality of pigs destined to the production of Teruel hams. Each treatment was replicated four times (ten pigs penned together). Animals were fed a commercial wheat, barley, and soybean meal diet containing 2,430 kcal NE/kg and 0.80% total lysine. Average daily gain and average daily feed intake were not affected by SW ($P > 0.05$), but feed conversion increased linearly ($P < 0.05$) at a rate of 0.08 kg for every 10 kg of BW increase. A linear relationship between SW and dressing percentage, backfat depth, and fat over the Gluteus medius muscle was detected suggesting increases by 0.5 percentage unit, 2.1 mm, and 2.0 mm, respectively, for every 10 kg extra BW at slaughter ($P < 0.001$). Weight of trimmed loins, shoulders, and hams increased with weight ($P < 0.001$). However, trimmed shoulder yield was not affected by SW ($P > 0.05$). Also, there was a linear relationship between SW and trimmed loin and ham yields ($P < 0.001$), indicating 0.17 kg and 0.30 kg decreases, respectively, for every 10 kg increase in SW. It is concluded that an increase in slaughter weight impaired productive performance of pigs, but might improve carcass quality. Slaughtering at more than 125 kg BW might help to optimize carcass characteristics of pigs destined to production of Teruel hams.

Key Words: Slaughter Weight, Teruel Ham, Pigs

W368 Change of characteristics of rib eye with cut section of pork using computer image analysis. M. Oishi*, Y. Furumoto, S. Hidaka, and K. Kuchida, *Obihiro University of A & VM*, *Obihiro, Hokkaido, Japan*.

The objective of this study was to determine how shape, color and marbling change with the cut section of pork loin. Rib loins

between 4-5th and the last rib of 6 barrows and 6 gilts of 3-way crossbred([Landrace × Large White] × Duroc) were cut into 18 slices with 2.5cm interval. Slice 1 was for 4-5th rib and slice 18 was for the last rib. High quality digital images of each section were taken by a mirror type camera for carcass cross section. For each section, nine traits were measured using an image analysis software (i.e., rib-eye area, fat area ratio, index of overall marbling coarseness, minor-major axis ratio, complexity of rib-eye shape, and RGBY values for rib eye color). At the same time, rib eye color (L*, a* and b* value) was measured with a colorimeter, and then the crude fat contents in rib eye was determined by chemical analysis for each slice. Correlation coefficients between Y and L* value, between the crude fat and fat area ratio were 0.825 and 0.740, respectively. The sections were classified into six positions by three slices backward from the front (e.g., position 1 = slices 1-3, position 6 = slices 16-18). Analysis of variance was performed by the SAS program for the image analysis traits as dependent variables and positions as fixed effects. Least square means (LSM) of the minor-major axis ratio for positions 1-6 were 0.62, 0.61, 0.58, 0.57, 0.49 and 0.39, respectively. Those of the fat area ratio were 3.80, 2.78, 2.13, 2.48, 2.50 and 3.24. Corresponding LSM of Y values were 121.59, 116.23, 112.06, 113.95, 115.19, and 117.72. From these results, rib-eye shape became flat toward the last position. Also the fat area ratio decreased in middle positions and then increased toward the last position. Marbling coarseness had the same trend with the fat area ratio. Brightness of rib eye was decreased in middle positions and then increased toward the last position.

Key Words: Pork, Image Analysis, Loin

Teaching/Undergraduate & Graduate Education

W369 Evaluation of Mississippi State University equine curriculum. M. Nicodemus* and K. Slater, *Mississippi State University*, *Mississippi State*.

With the growth of the equine industry, the demand for more university equine programs is increasing. Faculty has a challenge of trying to address the needs of the equine student as they prepare for jobs in a very diverse equine industry. To better develop a curriculum that meets the needs of the equine student, a survey was given to students (n=78) currently enrolled in equine classes at Mississippi State University. Questions addressed the students' background and interests concerning horses. The majority (74%) of students were Animal & Dairy Sciences majors with a science concentration with only 15% pursuing an equine management/production concentration. The majority of students had participated in or attended a horse show or clinic (69%) and had owned or family members had owned a horse (83%). 68% were planning on pursuing a career in the equine industry with 61% of those students choosing a veterinary career. Horse Science ranked first (41%) in equine classes that the students were currently taking or had taken followed by Equine Conformation & Performance Evaluation (20%). The majority (68%) of students indicated that they were taking equine classes because the classes "fulfilled a degree requirement" and the students "enjoyed horses", while 15% were taking classes just because they "enjoyed horses". Horse Science (17%) and Advanced Horsemanship (17%) were ranked as students' favorite equine classes in which both have a hands-on component. Equine Behavior & Training ranked the highest (23%) in equine classes the students wanted to take in the future followed by Western Equitation (19%) and Equine Reproduction (19%). Riding classes ranked the highest (58%) for recommended equine classes to add to the curriculum followed by an advanced horse science (35%). Overall, a hands-on component to the equine classes was a motivation for students taking an equine class. Laboratory components have been recently added to several of the equine classes to meet students' needs. Additionally, both Equine Reproduction and Advanced Horsemanship are only offered as a special topics class, but with favorable responses from this survey, these classes are currently being added to the curriculum.

Key Words: Horse Science, Teaching

W370 Development of an animal science managerial mentoring program. J. S. Pendergraft and B. T. Gutierrez*, *Sul Ross State University*, *Alpine, TX*.

The main goal of this project was to develop a managerial mentoring program for incoming animal science students. A model was developed to create a realistic workplace experience for animal science students outside of the classroom. The equine science program was divided into four specialized managerial areas: stables, nutrition lab, reproduction lab, and exercise physiology lab. One manager position with several specialized assistant manager positions were created. Additional staff positions were created under each assistant manager's area of responsibility. The equine science coordinator interviewed and hired the barn manager who in turn interviewed and hired the assistant managers. All hiring of positions were supervised by the equine science coordinator. All manager positions were renewable each year and staff positions were renewed each semester allowing for more diversity in a student's experience. A mentoring program for incoming equine science students was incorporated into the managerial model. The manager and assistant managers were responsible for mentoring their staff. Each incoming equine science student participating in the mentoring program committed 30 hours to each specialized area. Students successfully completing the mentoring program could choose to continue for a second semester of mentoring to gain more experience or apply for a mentoring position. During the first semester of the managerial mentoring program in the fall of 2006 three students participated as mentees. Two of these students are continuing the mentoring program during their second semester. One mentee chose to become a mentor during her second semester. The head manager/mentor obtained employment after graduation as a mare manager for a Thoroughbred farm in New Zealand. Eight new students entered the mentoring program during the spring of 2007. The main outcome from the Hispanic Serving Institute grant project was the development of a managerial mentoring model that can be used for any livestock program. The impact from this model was students were able to gain viable realistic workplace experience for the development of life skills that will be desired by future employees. Project progress can be found at: http://faculty.sulross.edu/jeffp/Equine/HSI.htm.

Key Words: Experiential Learning, Mentoring

W371 Animal welfare assessment scenarios as a tool for animal production industries. J. M. Siegford*, C. Daigle, M. Tubbs, T. Bernardo, C. R. Heleski, R. Malinowski, and R. Snider, *Michigan State University*, *East Lansing*.

Hypothetical comparative scenarios depicting welfare of animals in various scenarios have been developed at Michigan State University (MSU) to teach students to assess animal welfare. These welfare assessment scenarios have been used in collegiate Animal Welfare Judging Contests and in courses at MSU and other institutions. In addition to teaching students about animal welfare, the scenarios foster development of critical thinking skills and problem solving abilities. Scenario development begins by identifying a species or situation of interest and collecting scientific and management information from experts, in industry and academia, and through searches of the literature. The information is synthesized into a PowerPoint-type presentation with images and video to develop two realistic, yet fictitious situations which can then be compared. Animal industries could proactively address animal welfare issues by developing and using welfare assessment scenarios with a production emphasis. Such scenarios could help identify animals or situations where animal welfare could be improved and offer staff education in an area of increasing public concern. The scenarios can be tailored to emphasize management practices, facility design, veterinary care, or nutritional regimes for a particular species or production setting to identify areas for improvement and expansion. Welfare assessment scenarios could thus provide an unbiased internal assessment of current practices and conditions to facilitate any necessary internal changes directed at an individual worker, production unit, or entire facility. Scenarios could also be helpful in training new stockpersons by reinforcing proper animal practices related to meeting the needs of the animal physically, mentally and psychologically. By collaborating with industry to develop production-based animal welfare assessment scenarios, a positive relationship between the industry and MSU can be strengthened. The goals of such collaboration are to improve welfare of animals in production, support education for staff, and produce MSU students able to assess animal welfare based on scientific research and reasoning.

Key Words: Well-Being, Welfare, Education

W372 Poultry production demonstration: The effects of breeder hen's age on incubation, broiler growout and processing of broilers. G. M. Pesti*, R. I. Bakalli, and M. Y. Shim, *University of Georgia*, *Athens*.

The objectives of this laboratory exercise were to demonstrate: 1) the effects of the breeder's life cycle on fertility, hatchability and embryonic mortality patterns; 2) to compare the growth, feed efficiency and mortality of broilers hatched from large and small eggs laid by older and younger hens; and 3) to compare carcass characteristics of male and female chicks from two feedings programs. Average results from of 5 years of laboratories starting with 1080 eggs each from older hens (avg age = 63 weeks) and younger hens (avg age = 28 weeks) were: egg weight, 67 vs 54g; fertility, 80 vs 94%; hatch of eggs set, 71 vs 86%; chicks weight, 47 vs 38g; and mortality 7 vs 6%; for old hens vs young hens respectively. For the broiler grow out project, 30 chicks from each hen's age and chick gender were placed in 4 replicate pens (120 per treatment),and fed either a least cost diet (LC) with 16% protein and maximum profit (MP) diet with 24% protein. Average duration of broiler experiments was 40 days. Main effects means for chicks from old vs young hens were: body weight gain (BG), 2.35 vs 2.24 kg; feed conversion ratio (FCR), 1.74 vs 1.73 g feed/g gain; and mortality (M), 2.64 vs 4.17 %. Main effects of male vs females: BG, 2.45 vs 2.13 kg; FCR, 1.71 vs 1.75 g/g; and M, 4.19 vs 2.61. Main effects of diet were: BG, 2.26 vs 2.32 kg; FCR, 1.82 vs 1.64 g /g; and M, 4.03 vs 2.78%. Three chickens from each pen were randomly selected for processing. Main effects chicks source (old vs young hens) where: chilled carcass weight (CHCW) 72.5 vs 71.6%; abdominal fat (FP) 2.0 vs 1.8%; breast meat yield (BMY) 25.1 vs 24.8%; and leg quarters (LGW) 30.8 vs 30.7 %. Main effects male vs female where: CHCW, 72.7 vs 71.4%; FP, 1.7 vs 2.1%; BMY, 25.2 vs 24.6%; and LGW, 31.3 vs 30.2%. Main effects LC vs MP diets where: CHCW, 70.6 vs 73.5%; FP, 2.3 vs 1.5%; BMY 23.4 vs 26.4%; and LGW 31.3 vs 30.2%. The laboratory exercise described allows students to learn various techniques of incubation and husbandry while observing how breeder age, gender and type of feed influence incubation, broiler production and processing parameters.

Key Words: Education, Broilers, Processing

W373 Effect of management type, conventional versus organic, on production and culling in Southeastern Pennsylvania dairy herds. K. E. Griswold*[1], H. Karreman[2], and J. Mylin[3], [1]*Pennsylvania State University Cooperative Extension*, *University Park*, [2]*Penn Dutch Cow Care*, *Gap, PA*, [3]*Lancaster DHIA*, *Manheim, PA*.

The effect of management type, conventional versus organic, on production, health and culling was evaluated using Dairy Herd Improvement Association (DHIA) data from 68 dairy cattle herds in Southeastern Pennsylvania. Initially, 34 organically-managed (OM) herds were recruited for the study. Then, each OM herd was matched with a conventionally-managed (CM) herd of similar size and breed geographically located within a one-mile radius of the OM herd. These 34 matched pairs were selected to limit the effects of herd size, breed, local weather patterns and soil type on the results of the study. All herds used Lancaster DHIA services, and monthly DHIA 202 report data from 2006 were used for the study. Herds ranged in size from 22 to 105 cows with a mean size of 47 ± 6. Data were analyzed using PROC MIXED within SAS. While the majority of herds were Holstein, several (n = 9) of the OM herds were classified in DHIA as crossbred. As a result, the model included the fixed effect of management type with breed (Holstein versus Crossbred) nested inside management type. LS means with standard errors are presented in the table below. The results would indicate that OM herds produced less milk of poorer quality compared to CM herds. However, OM herds had greater milk component percentages, and lower culling rates compared to CM herds. The reduced culling rate resulted from less culling for reproduction and injury/other. Within OM herds, crossbreeding significantly lowered milk production and quality, but improved milk components and pregnancy rate. These results suggest that OM dairy herds face different production and health challenges compared to CM dairy herds, and the breed of cattle can further impact the production and health challenges in OM herds.

Table 1. Effect of management & breed on production & health

Item	Mgmt			Breed			P-value	
	Conv	Organic	SE	Holstein	Cross	SE	Mgmt	Breed
Milk, kg/cow/d	31.4	22.6	0.63	25.5	19.7	0.91	<0.0001	<0.0001
Fat, %	3.77	3.94	0.039	3.78	4.09	0.057	0.0039	0.0005
Protein, %	3.06	3.15	0.019	3.03	3.27	0.027	0.0021	<0.0001
SCS	2.94	3.29	0.090	3.12	3.46	0.132	0.0092	0.0853
Preg. rate, %	17.7	19.5	1.03	16.6	22.3	1.50	0.2307	0.0107
Cows left herd, %	32.5	27.0	1.74	26.8	27.2	2.54	0.0303	0.9181
for repro, %	7.3	4.2	0.90	6.7	1.8	1.27	0.0182	0.0116
for injury/other, %	5.7	2.9	0.95	3.8	2.0	1.38	0.0382	0.3736

Key Words: Organic, Conventional, Herd Health

Wednesday, July 11, 2007
SYMPOSIA AND ORAL SESSIONS

Animal Health - Livestock and Poultry: Poultry and Swine II

685 Gene expression of alpha-toxin and *Clostridium perfringens* colonization in the development of necrotic enteritis disease in broiler chickens. W. Si[1], J. Gong[1], Y. Han*[2], H. Yu[1], H. Zhou[1], and S. Chen[3], [1]*Food Research Program, Agriculture and Agri-Food Canada*, *Guelph, Ontario, Canada*, [2]*Maple Leaf Foods Agresearch*, *Guelph, Ontario, Canada*, [3]*Labotory Service Division, University of Guelph*, *Guelph, Ontario, Canada*.

Alpha-toxin produced by *Clostridium perfringens*(CP) is considered one of the major virulence factors for necrotic enteritis (NE). This study was conducted to study alpha-toxin production at the gene expression level and its relationship to CP proliferation in the development of NE lesions in broiler chickens. 600 d-old birds were reared in 12 pens (50 birds/pen) and were fed either a medicated diet (55ppm bacitracin) or a non-medicated diet. The birds were challenged with a type A CP inoculum at a concentration of 10^7 CFU/ml on day 18. Two birds per pen were then humanely killed daily for 4 consecutive days. Ileal digesta was collected to analyze CP counts and alpha-toxin gene expression. NE lesions were scored on days 20, 21, and 22. The gene expression of alpha-toxin was quantified by two-step q-RT real-time PCR analysis. The birds fed the medicated control diet showed no NE lesions, undetectable alpha-toxin gene expression, and a mean CP counts of 0-13 CFU/g of digesta. In contrast, birds fed the non-medicated diet developed visible NE lesions 2 days after the infection (day 20). The average CP counts in the digesta of birds fed the non-medicated diet were 7 CFU/g before, and 1.3 x 10^4-2.0 x 10^7 CFU/g after the infection. Birds fed the non-medicated diet also had higher numbers of infected birds, NE scores, ileal CP counts, and alpha-toxin gene expression on day 20. Alpha-toxin gene expression reached a peak on day 20 and started to decline on day 21. All the infected birds fed the non-medicated diet demonstrated a highly positive correlation between the gene expression of alpha-toxin and cell proliferation of CP (R^2=0.7606, $P < 0.0001$). It appears that there was a threshold of counts of the alpha-toxin producing CP for the development of the disease.

Key Words: *Clostridium Perfringens*, Necrotic Enteritis, Alpha-toxin

686 Comparison of the severity of Necrotic Enteritis caused by *Clostridium perfringens* in broiler chickens given either an attenuated or non-attenuated live coccidial vaccine. G. Mathis*[1] and C. Hofacre[2], [1]*Southern Poultry Research, Inc.*, *Athens, GA*, [2]*University of Georgia*, *Athens*.

Two studies were conducted to evaluate the degree of severity of Necrotic Enteritis in broiler chickens challenged or vaccinated with either an attenuated or non-attenuated live coccidial vaccine. The challenge study used battery cages. The treatments were no coccidia challenge, non-attenuated (NA) coccidia challenged, and attenuated (A) coccidia challenged. Both coccidial inoculums were mixtures of *E. acervulina, E. maxima*, and *E. tenella*. Birds were coccidia challenged on Day 14. All birds were dosed with *Clostridium perfringens* on Days 19, 20, and 21. The performance parameters measured were feed conversion and weight gain. The percent NE mortality for the A challenged birds was 2%, compared to 20% for the NA challenged birds. Significantly better performance and lower NE lesion scores were observed with the A challenged birds compared to the NA challenged birds. The vaccine study was conducted in a floor-pen facility. The treatments were non-vaccinated, non-challenged or challenged, coccidia vaccinated with attenuated or non-attenuated vaccine and challenged. Vaccination was performed on day of hatch, prior to placement. Challenged birds received *Clostridium perfringens*. Presence of litter oocysts in all vaccinated pens confirmed viability of both vaccines. The non-attenuated vaccinated birds had higher percent NE mortality and NE lesion scores and lower performance at Days 22 and 42 compared to attenuated vaccinated birds. The results demonstrate that the severity of Necrotic Enteritis was not as much in birds challenged with attenuated strains of coccidia than the non-attenuated coccidial strains.

Key Words: Necrotic Enteritis, Vaccine, Coccidia

687 Efficacy of CloSTAT™ direct-fed microbial for control of experimentally induced necrotic enteritis by *Clostridium perfringens* in broiler chickens. B. Boren*[1], G. F. Mathis[2], C. L. Hofacre[3], and S. Moore[1], [1]*Kemin AgriFoods North America*, *Des Moines, IA*, [2]*Southern Poultry Research*, *Athens, GA*, [3]*University of Georgia*, *Athens*.

An experiment was conducted to determine if CloSTAT™ could affect the severity of experimentally induced Necrotic Enteritis (NE) and lessen related production losses. Chicks were assigned to 1 of 6 treatments each replicated 8 times. Birds were reared 8 chicks per battery brooder pen. Three doses of CloSTAT: 1 x 10^{10}, 1 x 10^9 and 1 x 10^8 cfu/ton mash starter feed were tested in 384 male, Cobb x Cobb 500 broilers. The 3 control treatments were: an unmedicated, uninfected positive control; an unmedicated, infected negative control; and an infected, antibiotic control receiving 50g Bacitracin MD

(BMD)/ton feed. All birds were infected on day 14 with a mixed coccidial inoculum containing 25,000 oocysts of *E. acervulina*/bird and 5,000 oocysts of *E. maxima*/bird. On days 19, 20 and 21, all birds, with exception of positive controls, received a dose of 1 x 10^8 cfu of a *C. perfringens* strain proven to induce NE via cultured broth provided fresh daily. BW (0 to 22-day) of broilers fed CloSTAT at 1 x 10^{10} cfu/ton was higher vs. negative control (P<.05). By day 27, CloSTAT at all tested doses proved as efficacious (P<.05) in protecting against NE model as BMD and not significantly different (NSD) from uninfected positive controls. FCR of negative controls (0 to 27 days) was higher (P<.05) than those of all other treatment means and were NSD from one another. NE mortality of CloSTAT-treated chicks was lower (P<.05) for those receiving 1 x 10^9 cfu/ton (9.4%) than those fed 1 x 10^8 cfu/ton (20.3%); with both NSD from highest CloSTAT dose of 1 x 10^{10} cfu/ton (10.9%). Mortality due to NE of BMD was NSD from any CloSTAT treatment. Therefore, of the birds challenged with *C. perfringens*, those receiving CloSTAT lived as well as birds receiving BMD at 50g/ton. Based on the results of this study, CloSTAT proved effective in reducing NE mortality and related production losses.

Key Words: Clostridium, Chicken, Necrotic Enteritis

688 Immune interference of bacteriophage efficacy to treat colibacillosis in broiler chickens. W. E. Huff*, G. R. Huff, N. C. Rath, and A. M. Donoghue, *USDA/ARS Poultry Production and Product Safety Research Unit, University of Arkansas*, *Fayetteville, AR*.

Bacteriophage are viruses that kill bacteria, and may provide a natural and safe alternative to antibiotics. Colibacillosis is an important poultry disease caused by *Escherichia coli*. Previous work has indicated that bacteriophage could be used to both prevent and treat colibacillosis. However, bacteriophage may illicit an immune response in poultry, which could limit their effectiveness to treat bacterial diseases. The experimental design to investigate this possibility consisted of 5 treatments with 3 replicate floor pens of 20 birds per pen. The treatments were control, birds administered bacteriophage at 10 and 17 d of age, birds challenged with *E. coli* at 17 d of age, birds challenged with *E. coli* and administered bacteriophage at 17 d of age, and birds administered bacteriophage at 10 and 17 d of age and challenged with *E. coli* at 17 d of age. Five extra birds were placed in the pens of the control treatment and the treatment only administered bacteriophage. These extra birds were bled and euthanizied at 17 d of age for viral neutralization assay development. All remaining birds were necropsied at 31 d of age. Bacteriophage were administered into the thigh muscle providing 6.7 X 10^8 pfu. The birds were challenged with an airsac inoculation of *E. coli* delivering 1 X 10^6 cfu per bird. Mortality was significantly reduced by bacteriophage from 55% in the *E. coli* treatment to 8% in *E. coli* challenged bacteriophage treated birds, and reduced, but not significantly, to 33% in the birds that were administered bacteriophage 7 d prior to the *E. coli* challenge, and consequently treated with bacteriophage. The neutralization assays suggest that the activity of bacteriophage was compromised by the bird′s immune response. Although bacteriophage can be developed as an alternative to antibiotics for specific applications, bacteriophage efficacy to treat bacterial diseases may be affected by repeated intramuscular administration of bacteriophage due to immune interference.

Key Words: Bacteriophage, Colibacillosis, Poultry

689 Effect of lactic acid bacteria probioitc culture treatment timing on *Salmonella* in neonatal broilers. J. P. Higgins*, S. E. Higgins, V. Salvador, A. D. Wolfenden, G. Tellez, and B. M. Hargis, *University of Arkansas*, *Fayetteville*.

We evaluated the ability of a commercially available probiotic culture (FM-B11™ Ivesco LLC; LAB1) or a combination of 3 ATCC lactobacilli (LAB2) to reduce *Salmonella enterica* serovar Enteritidis (SE) in day-of-hatch broiler chicks. In Experiments 1 - 3, chicks were challenged with SE and then treated 1 h later with LAB1 or LAB2. Significantly less cecal SE was recovered from LAB1 treated chicks 24 h following treatment as compared to controls (48 - 76 % reduction) or LAB2 treated chicks (48 - 68 % reduction) in all three experiments ($P < 0.05$). LAB2 significantly reduced cecal SE recovery 24 h following treatment as compared to controls in Experiments 1 and 3 (24 - 29 % reduction) ($P < 0.05$), but not in Experiment 2. In Experiments 4 - 7, LAB1 was administered 24 h prior to SE challenge. LAB1 significantly reduced recovery of SE as compared to controls (60 - 78 % reduction) ($P < 0.05$) in Experiments 4 and 5, but not Experiments 6 and 7. In Experiments 8 - 10, chicks were first challenged with SE, then treated 24 h later with LAB1, and no reduction in cecal SE was observed. Together, these data demonstrate that the timing of probiotic treatment in relationship to SE challenge greatly affects the ability of LAB1 to reduce SE recovery. Furthermore, probiotic LAB1 significantly reduced cecal SE incidence as compared to LAB2 treatment, demonstrating that not all lactic acid bacteria are equally effective at reducing enteric pathogens in poultry.

Key Words: *Salmonella*, Probiotic, *Lactobacillus*

690 Evaluation of methods for detecting influenza viruses in wild aquatic birds. T. V. Dormitorio*, J. J. Giambrone, K. Guo, and G. Hepp, *Auburn University*, *Auburn, AL*.

It is generally accepted that wild aquatic birds are the natural reservoirs of influenza viruses that infect other species including humans. There are a number of variables to consider when developing laboratory protocols for detecting avian influenza viruses (AIVs) in wild waterfowl. Egg embryo inoculation, hemagglutination, AC-ELISA and real-time RTPCR (RRT-PCR) were used to detect AIVs from cloacal swabs of wild ducks from Southeastern United States. No AIV was detected when cloacal samples (HA positives) were used directly for either RRT-PCR or AC-ELISA tests. AIV was detected 12 cycles earlier on allantoic fluid of egg inoculated on the 2nd passage. AC-ELISA detected influenza A only when the HA titer of the virus in the allantoic fluid sample was 256 or higher. Many factors such as inhibitors, RNA extraction, etc., could be responsible for the failure of the test to detect AIVs. The RRT-PCR appeared to be a more sensitive, cost-effective and rapid assay however, it still needed embryo inoculation, which is time-consuming and labor intensive.

Key Words: Real Time RT-PCR, Hemagglutination, ELISA

691 Evaluation of a novel recombinant salmonella vaccine vector for avian influenza. K. Cole*[1], S. L. Layton[1], M. M. Cox[1], Y.M. Kwon[1], L. R. Berghman[2], W. G. Bottje[1], and B. M. Hargis[1], [1]*University of Arkansas*, *Fayetteville*, [2]*Texas A&M University*, *College Station*.

Avian influenza is a significant public health concern and serious economic threat to the commercial poultry industry worldwide. Previous research demonstrates that antibodies against M2e confer protection against influenza challenge. Using the Red recombinase system in combination with overlapping extension PCR, we recently developed several novel attenuated ΔSE)aroA Salmonella enteritidis strains (ΔSE) that express a protective M2e epitope alone or in combination with a potential immune-enhancing CD154 peptide sequence on the outer membrane protein lamB. These recombinant Salmonella strains (ΔSE, ΔSE-M2e, ΔSE-M2e-CD154, or ΔSE-M2eX4-CD154) were evaluated in chicken vaccination studies (challenge dose: 105-107 cfu/chick via oral gavage at day-of-hatch). Liver/spleen and ceca tonsils were aseptically removed at 7 d post-challenge for detection of ΔSE strain recovery, and blood samples were obtained for determination of M2e-specific IgG antibody response at 10 and 20 d post-challenge. Within challenge doses, no significant ($p>0.05$) differences were observed in ΔSE strain recovery from cecal tonsils (colonization) at d 7. However, marked differences in organ invasion were observed ($p<0.05$). Vaccinated chickens exhibited significantly increased M2e-specific IgG responses, which were further enhanced by simultaneous expression of CD154 ($p<0.05$). Virus neutralization assays using chicken embryos gave neutralizing indices of 7.5, 8.3 and 8.3 for ΔaroASE-M2e, ΔaroASE-M2e-CD154, and ΔaroASE-M2eX4-CD154, respectively, indicating effective neutralization of AI by serum IgG of vaccinated chickens. Continuing experiments are focused on duration of response, effect of booster vaccination, and protection against influenza challenge. Our preliminary data suggest that these Salmonella-vectored vaccines expressing M2e in association with CD154 are effective against AI.

Key Words: Vaccine, Salmonella, Avian Influenza

692 Differential antibody response to AIV vaccination in chickens with different Mx genotypes. X. Y. Li, L. J. Qu, Z. H. Ning, G. Y. Xu, J. Y. Li, Z. C. Hou, and N. Yang*, *China Agricultural University*, *Beijing, China*.

The chicken Mx gene has been shown to be associated with the resistance to avian influenza virus (AIV). In this study, heterozygote (AG) parents with respect to the Mx gene S631N mutation were identified in a line of egg-type chickens and used to reproduce a segregation population. Chicks were divided into three groups based on the genotypes at the S631N site of the Mx protein: 58 chicks with AA, 56 with AG and 53 with GG genotypes, whereas A and G represent resistant and susceptible alleles to AIV, respectively. All experimental birds were vaccinated with 0.3 mL inactivated H5N2 AIV vaccine twice at 14 and 45 days of age. Blood samples were taken for each chicken before vaccination and at week 1, 2, 3, 4, 5, 7, 9 and 15 after the first vaccination, and the antibody titers to AIV measured using HI test. For the initial vaccination, the antibody levels were high with substantial maternal antibody, and there was no significant difference in antibody response among different genotypes. After the boosting vaccination, however, chickens with homozygous resistant allele (A) showed the lowest antibody response, whereas the heterozygous chickens (AG) presented the highest antibody level. The result implied that genetic background might interfere the effects of AIV vaccination.

Key Words: Avian Influenza, Mx Gene, Antibody

693 Impact of ergot infested sorghum on the reproductive performance of sows. G. M. AbdRahim*[1], R. C. Richardson[2], and A. Gueye[3], [1]*Alabama A&M University*, *Normal*, [2]*Texas State University*, *San Marcos*, [3]*Mt. Ida College*, *Newton, MA*.

Over two parities, the impact of three levels of sorghum infected with ergot alkaloids on the reproductive performance of sows was evaluated. The three levels of ergot alkaloids fed to sows were 0 ppm, 12 ppm, and 24 ppm. Eighteen sows similar in weight, age and breed were used in the experiment. Sows were selected randomly and assigned to the three treatments and fed 2.3 kg of DM/d of a diet based on ground grain sorghum during the gestation and lactation periods. With the exception of the control treatment, the same sows were used during the first and second parities. The number of pigs farrowed, and weights of pigs within 24 hours after birth and at 28 days of age were recorded for each litter. Lactation feed intake, interval to estrus, and weight at d-56, were determined throughout each parity. In the first parity, ADG at d- 28, and interval to estrus were affected by the level of ergot alkaloids in the diet. ADG at d-28 was greater ($P < 0.05$) for born pigs from sows fed the 24 ppm ergot alkaloids treatment than born pigs from sows fed the 12 ppm. In the same parity, the level of 12 ppm ergot alkaloids resulted in prolonged estrus interval ($P < 0.05$) over the 24 ppm treatment. In the second parity, variables that were affected by the level of ergot alkaloids were average weight of live pigs born and lactation feed intake. Average weight of live pigs born was greater ($P < 0.05$) in sows fed the 24 ppm and 12 ppm ergot alkaloids treatment than in sows fed the for 0 ppm treatment. The lactation feed intake was greater ($P < 0.05$) for sows fed the 0 ppm than for sows fed the 12 ppm. Statistical analysis of the combined results from parity one and parity two showed that the only variable affected by the treatments was ADG at d-28. ADG at d-28 was greater ($P < 0.05$) for born pigs from sows fed the 0 ppm and 24 ppm ergot alkaloids than for born pigs from sows fed the 12 ppm. Overall, variables that were affected by the infestation of grain sorghum by the ergot alkaloids were pigs gain to d-28, lactation feed intake, and interval to next estrus.

Key Words: Alkaloids Ergot, Sorghum, Sows

694 The effect of dam parity on circulating immunoglobulins (Ig) in neonatal swine. T. E. Burkey*, R. K. Johnson, P. S. Miller, D. E. Reese, and R. Moreno, *University of Nebraska*, *Lincoln*.

The belief that dam parity can affect progeny performance and survival has contributed to the establishment of parity-segregated management systems in the pork industry. To date, little experimental evidence exists that directly challenges the idea that dam parity affects progeny health statues and performance. The objective of this experiment was to evaluate and compare concentrations of IgA and IgG in serum obtained from the progeny of first parity (P1) and third parity (P3) females in order to gain insight into parameters that may be affected by dam parity. Neonatal piglets ($n = 9$) were selected from the progeny of either P1 or P3 females ($n = 4$ each from the P1 or P3 population) for inclusion in the study. Whole blood was collected via jugular venipuncture from piglets at 1, 8, 15, 20 (weaning), 29, and 37 d following parturition and concentrations of IgA and IgG were determined via swine-specific enzyme-linked immunosorbent assays (ELISA). Serum samples were diluted 1:2000 for IgG determination and 1:100,000 for IgA determination. Individual BW were recorded at similar time points. A significant parity by time interaction existed for circulating IgA. Within time point (d), P3 progeny had greater ($P < 0.05$) concentrations of IgA than P1 progeny on d 1, 8, and 37.

A similar interaction was not observed for IgG. Averaged across all time points, P3 progeny had greater ($P < 0.009$) concentrations of circulating IgG than P1 progeny. Piglet BW did not differ between parities. These results suggest that circulating Ig concentrations in neonatal pigs may be affected by dam parity. It remains to be determined whether the increase in circulating Ig observed in P3 progeny occurred because P3 females had greater capacity to provide passive transfer of Ig during lactation. Additional work is needed to determine whether these effects afford the progeny of dams of increasing parity advantages in health and performance during subsequent growth phases.

Key Words: Dam Parity, Immunoglobulins, Swine

695 Impact of ochratoxin A and zearalenone on weaning piglets and counteracting. V. H. Starkl*[1] and M. Forat[2], [1]*Biomin GmbH*, *Herzogenburg, Lower Austria, Austria*, [2]*Instituto Internacional de Investigacion Animal*, *Queretaro, Mexico*.

Mycotoxins are ubiquitously present, secondary metabolites of different fungal species. Ochratoxin A (OTA) is nefro- and hepatotoxic, carcinogenic and immunesuppressive at low concentrations. Zearalenone (ZON) is known to mimick estrogene and thus leading to hyperestrogenism. A trial was performed to evaluate the effects of 500ppb OTA and 250ppb ZON on health and performance of weaned piglets. The trial started at day 21 and ended on day 63. 96 piglets were randomly separated into 4 treatments. As both, OTA and ZON, are only partly adsorbable, Mycofix® Plus (MP) a product based on biotranformation was tested. The product consists of two microorganisms, *BBSH 797* and *Trichosporon mycotoxinivorans*, that produce specific enzymes to biotransform trichothecenes, ZON and OTA. The following four treatments were applied: T-1 Control diet; T-2 500ppb OTA + 250ppb ZON, no MP; T-3 500ppb OTA + 250ppb ZON, 500g MP/ton of feed; T-4 500ppb OTA + 250ppb ZON, 1000g MP/ton of feed. Non-purified toxins provided by Biomin® were used. ANOVA was used for statistical evaluation. Measured parameters included performance parameters (feed consumption, body weight, mortality) and histopathology of liver, kidneys and uterus. Daily weight gain over trial period and subsequently final bodyweight were significantly lower in T-2, whereas both treated groups T-3 and T-4 did not show any difference to the control group in performance parameters. No clinical signs were diagnosed in treatment T-1. In treatment T-2 swollen vulva (41,6%), swollen prepuce (50,0%), rectum prolapse (25,0%), vomiting (4,1%) diarrhea (4,1%) and frequent urination (50,0%) were diagnosed. Symptoms in MP-treated groups T-3, T-4 were significantly reduced or completely overcome. Histopathology showed clear impact of ochratoxin A as kidney- and liver-toxin. Remarkable was the effect of 250ppb zearalenone on the epithelia of uterus of piglets of 63 days of age: Focal squamous cells and mitotic cells were observed in epithelia of uterus of piglets in T-2. As a conclusion can be stated that OTA and ZON strongly affected weaning piglets and that Mycofix® Plus was able to overcome the negative impact.

Key Words: Ochratoxin A, zearalenone, Piglet

696 Dietary supplementation with *acanthopanax senticosus* extracts beneficially modulates the gut microflora in weaned pigs. X. F. Kong*[1], Y. L. Yin[1], W. Y. Chu[2], F. G. Yin[1], H. J. Liu[1], F. F. Xing[1], Q. H. He[1], T. J. Li[1], R. L. Huang[1], P. Zhang[1], S. W. Kim[3,4], and G. Y. Wu[1,4], [1]*Institute of Subtropical Agriculture, The Chinese Academy of Sciences*, *Changsha, Hunan, China*, [2]*Nanjing Agricultural University*, *Nanjing, Jiangshu, China*, [3]*Texas Tech University*, *Lubbock*, [4]*Texas A&M University*, *College Station*.

This study was conducted to investigate the effects of *acanthopanax senticosus* extracts (ASE) as a dietary additive on gut microflora in weaned pigs. Sixty pigs weaned at 21 d of age were randomly assigned to one of the three 3 treatments (20 pigs/treatment), representing supplementation with 0 or 0.1% ASE, or 0.02% colistin (an antibiotic) to a corn- and soybean meal-based diet. On d 0, 7, 14 and 28 after initiation of the supplementation, five 5 pigs from each treatment were euthanizedsacrificed to obtain the luminal contents of the ileum, jejunum, and cecum. The intestinal luminal samples were analyzed for the gut microflora using the polymerase chain reaction-denaturing gradient gel electrophoresis technique. The concentrations of lactobacillus and E. coli were determined using the in vitro culture methodology. The results indicated that the gut microflora of ASE-supplemented piglets was more diverse than the other 2two groups of piglets ($P < 0.05$). Particularly, the number of lactobacillus was higher ($P < 0.05$) and the number of E. coli was lower ($P < 0.05$) in ASE-supplemented pigs, compared with the other 2two groups of pigs. These findings suggest that dietary supplementation with ASE beneficially modulates the development of the gut microflora, suppresses the number of bacterial pathogens, and promotes a healthy intestinal environment in weaned pigs. We suggest that ASE is an effective alternative to a feed antibiotic for young pigs. (Supported by NSFC and CAS)

Key Words: *Acanthopanax senticosus* Extracts, Weaned Pigs, Gut Microflora

Nonruminant Nutrition: Poultry Nutrition - Ingredient and Mineral Nutrition

697 Investigation of antagonism and absorption of zinc and copper when different forms of minerals were fed to chicks. T. Ao*, J. L. Pierce, R. Power, A. J. Pescatore, K. A. Dawson, A. H. Cantor, M. J. Ford, and B. L. Shafer, *Alltech-University of Kentucky Nutrition Research Alliance*, *Lexington, KY*.

The aim of this study was to investigate the antagonism of Zn and Cu when organic or inorganic forms of these minerals were fed to chicks. A practical corn-soybean meal diet without Cu and Zn supplementation, containing 31 mg Zn /kg diet and 5.4 mg Cu /kg diet, was used as a basal diet. Bioplex Zn® (a chelated Zn proteinate) and Bioplex Cu® (a chelated Cu proteinate) were used as the organic sources. Reagent grade sulfate salts provided the inorganic sources of Zn and Cu. Supplements provided 20 ppm Zn and 8 ppm Cu. Ten groups of six day-old male broilers were assigned to each of seven treatments. Tap water with no detectable Zn and Cu (<0.001 ppm) and feed were supplied on an *ad libitum* basis during the 3 wk trial. Treatments consisted of the following dietary supplementation: 1) none, 2)

inorganic Cu, 3) inorganic Zn, 4) inorganic Zn + inorganic Cu, 5) inorganic Zn + Bioplex Cu, 6) Bioplex Zn + inorganic Cu, and 7) Bioplex Zn + Bioplex Cu. The luminal mucus layer of the chick's duodenum was separated from the mucosa by filling the lumen with agar to observe the Zn and Cu uptake of mucus in the agar cast and the mucosa. Weight gain and feed intake were increased by Cu ($P<0.01$) and were further increased by Zn or Zn + Cu ($P<0.01$). Gain to feed ratio was decreased ($P<0.01$) by Zn + Cu provided as inorganic forms but not as the organic forms, compared with Zn alone. Zinc supplementation increased ($P<0.01$) tibia and plasma Zn concentrations. Tibia Zn and Cu levels were higher ($P<0.01$) for the organic Zn + Cu treatment than for the inorganic Zn + Cu treatment. The Cu content in the mucosa of chicks fed both organic Zn and Cu was significantly higher ($P<0.01$) than that of chicks given no supplementation or both inorganic Zn and Cu. This suggests that the Bioplex form of Cu is more efficiently absorbed from the lumen and that the antagonism between Zn and Cu can be avoided through using proteinated forms of these minerals.

Key Words: Zinc, Copper, Antagonism

698 Body weight, carcass yield and intestinal clearance of broilers having Na and K salts in the drinking water during pre slaughter feed removal. H. A. Gomes, S. L. Vieira*, D. M. Freitas, and C. A. Torres, *Universidade Federal do Rio Grande do Sul*, *Porto Alegre, RS, Brazil*.

Ideally, pre slaughter feed removal in broilers should take between 8 and 12 hours. This time allow the intestinal contents to be cleared out, however body and carcass weight are reduced. In this study, Na and K salts were added to the drinking water and given to 46 d old broilers during a 24 hour pre slaughter period. From these, the last 12 hours corresponded to the feed removal period. Six hundred and forty eight Cobb X Cobb 500 broilers were placed in drinking water treatments having tap water or graded increases of 0.15, 0.30, and 0.45% sodium bicarbonate or potassium chloride. In a last treatment, birds were not allowed access to water. The 8 treatments had 9 replications of 9 birds each and were placed in 2.8 m2 floor pens at start. Each pen had one feeder and 3 nipple drinkers connected to a 20 L water tank with a volume scale, full at the beginning. Since one d old placement o 46 d all birds were on a ad libitum feed and water program. They were then kept out of feed for 3 hours and then allowed one hour access to feed after which the feed withdrawal period started. All birds were weighed at this time and one bird per pen was randomly sacrificed, eviscerated and had its entire gastro intestinal system weighed. Intestinal contents were collected from the crop through proventriculus and from the duodenum through the cloacae. Followed a standard carcass and cut up processing. This procedure was repeated every 2 hours until a total of 12 hours was attained and 7 birds per pen were sacrificed. Water intake was estimated at 2 hour intervals by checking the amount left in the tank compared to the amount in the immediately former period. At the end of the study, water intake demonstrated to be linearly increased with the use of salts in the water ($P<0.05$), regardless of the salt type. Body weight loss increased linearly through the feed removal period, however, it was higher with birds without access to water ($P<0.0001$). There were no effect of treatments on carcass and cut up yields as well as on the intestinal dry matter mass at any evaluated moment.

Key Words: Broiler, Feed Withdrawal, Drinking Water

699 The effect of dietary glycine and *Clostridium perfringens* challenge on whole blood chemiluminescence responses in broiler chickens. Z. Papp, J. P. Dahiya, G. Widyaratne, J. E. G. Smits, and M. D. Drew*, *University of Saskatchewan*, *Saskatoon, SK, Canada*.

Whole blood chemiluminescence (WBCL) is a simple and rapid method of measuring the production of reactive oxygen species by circulating polymorphonuclear leukocytes. WBCL was used as a method of assessing innate immune function in broiler chickens fed ideal-protein balanced diets with different protein and glycine concentrations and orally challenged with *Clostridium perfringens*. In Experiment 1, one-day-old male broiler chicks (Ross 308; N=144) were housed in two separate rooms with 12 cages of 6 birds per room. On day 14, four cages of birds in each room were randomly assigned to one of 4 diets containing 16 or 18% digestible crude protein and 0.98 or 1.75% glycine (gly) in a 2 x 2 factorial arrangement. All diets contained 9.80 MJ/kg net energy and 1.11% digestible lysine with all other essential amino acids at ideal protein levels. Birds in one room were challenged with 1 ml of an overnight culture of *C. perfringens* on days 14-21 and in the other room, birds were challenged with sterile PBS. On day 28, blood samples were collected for measurement of WBCL. Challenged birds had significantly higher WCBL responses than unchallenged birds (36,640 vs 26,370 cpm) and those receiving the 1.75% gly diets had significantly higher WCBL responses than birds fed the 0.98% gly diets (34,400 vs 28,374 cpm; $P < 0.05$). Digestible protein level had no significant effect on WCBL responses. In Experiment 2, two cages of 6 birds each were fed 1 of 4 diets containing 0.76, 2.10, 3.43 or 4.77% of gly. Net energy, amino acid levels and oral challenge with *C. perfringens* were as described for Experiment 1. On day 28 blood samples were collected for measurement of WBCL. The birds fed the 0.76% gly diet had significantly lower WCBL responses compared to birds fed the other 3 diets. The results demonstrate that dietary gly level and challenge of birds with *C. perfringens* significantly alters innate immune status of broiler chickens measured using WBCL.

Key Words: Glycine, Clostridium perfringens, Chemiluminescence

700 Live performance of broilers fed diets supplemented with the plant extract Sangrovit or a blend of organic and inorganic acids. S. L. Vieira*[1], D. M. Freitas[1], J. L. B. Coneglian[1], A. F. Klein[1], P. X. Silva[1], and O. Figueiró[2], [1]*Universidade Federal do Rio Grande do Sul*, *Porto Alegre, RS, Brazil*, [2]*Phytobiotics*, *Londrina, PR, Brazil*.

Quaternary benzo[c]phenanthridine alkaloids (QBA) sanguinarine and chelerythrine are plant extracts which have antimicrobial and anti-inflammatory properties usually present in the ratio of 3 to 1. Blends of organic and inorganic acids are used due to their antimicrobial properties in animal feeds. This study evaluated broiler performance when fed Sangrovit, a commercial extract marketed in several countries (1.5% sanguinarine) or a Blend of Acids (40% lactic, 7% acetic, 5% phosphoric and 1% butyric). One thousand five hundred and forty Cobb X Cobb 500 one day old male broiler chicks were placed in 44 floor pens, 35 per pen. All birds were fed corn-soybean meal feeds w/o traditional antibiotic growth promoters or anticoccidials. Feeds were provided as follow: 1 to 7 d, 8 to 21 d, 22 to 35 d and 36 to 42 d with 4 treatments and 11 replications in a RBD as follow: T1: Control Treatment w/o any additive; T2: Sangrovit 50 ppm added from 1 to 21 d and then 25 ppm to 42 d; T3: a Blend of Acids at 8 kg/ton from 0 to 7 d, 6 kg/ton from 8 to 21 d, 4 kg/ton from 22 to 35 d, and 2 kg/ton

from 36 to 42 d; T4: Sangrovit as in T2 + a Blend of Acids at 6 kg/ton from 0 to 7 d, 4.5 kg/ton from 8 to 21 d, 2 kg/ ton from 22 to 35 d, 1 kg/ton from 36 to 42 d. Birds were vaccinated for coccidiosis at placement with Paracox. All diets had nutrients and ME to meet or exceed NRC (1994). Body weight, feed intake and feed conversion were weekly evaluated. One bird per pen was sacrificed for evaluation of intestinal lesion scores as well as villi height and crypt depth at 7, 14 and 21 d, whereas 6 birds per pen were processed at 42 d. When compared to the Control Treatment, body weight was improved at 21 d when Sangrovit or the Blend of Acids was used ($P < 0.05$). Improvements in feed conversion were shown weekly and also in the overall period when using Sangrovit alone as well as when a combination with the Blend of Acids ($P < 0.05$). No differences due to the treatments were observed in terms of intestinal lesion scores or villi height and crypt depth at 7, 14 and 21 d, or for the yield of carcass and commercial cuts at 42 d.

Key Words: Broiler, Sanguinarine, Sangrovit

701 Effects of tannin concentration on nutritional value of sorghum grain in broiler chicks. C. R. Monge*[1], J. D. Hancock[1], C. Feoli[1], R. C. Kaufman[1,2], M. R. Tuinstra[1], S. R. Bean[1,2], S. Beyer[1], and B. P. Ioerger[2], [1]*Kansas State University*, *Manhattan*, [2]*USDA/ARS*, *Manhattan*.

A total of 192 broiler chicks (Cobb x Cobb, 7 d of age, and average initial body weight of 131 g) was used in a 7-d metabolism experiment to determine the effects of tannin concentration on nutrient utilization. A reference diet with 50% cornstarch was formulated to meet or exceed the nutrient concentrations recommended in the 1994 NRC for poultry. Sorghum grain was then substituted for cornstarch in the reference diet. The sorghum treatments were created by mixing 60% endosperm from non-tannin sorghum (Mycogen 627) with blends of pericarp from the non-tannin sorghum and a tannin sorghum (Sumac) as 40% of the composite. The pericarps were blended so the sorghum composites had none, 0.34, 0.68, 1.36, 2.72, and 5.44 mg of catechin equivalents/100 mg of DM (i.e., % CE). The birds were adjusted to treatment for 4 d followed by 3 d collection of excreta. The excreta were dried, ground, and analyzed for DM, N, and GE with Cr2O3 used as an indigestible marker. There was a linear decrease ($P < 0.03$) in average daily gain (ADG) and a trend (quadratic effect, $P < 0.08$) for decreased gain to feed ratio (G:F) as tannin in the sorghum was increased from none to 5.44% CE. The trend in G:F was consistent with quadratic responses ($P < 0.001$) in percentage retention of DM, N, and GE with concentration of tannins greater than 1.35% CE resulting in decrease nutrient utilization. For the none, 0.34, 0.68, 1.36, 2.72, and 5.44% CE treatments, ADG was 27.9, 26.7, 26.9, 26.8, 25.4, and 25.7 g/d, G:F was 811, 804, 854, 812, 786, and 757 g/kg, retention of DM was 72.8, 73.0, 74.3, 73.4, 68.9, and 65.2%, retention of N was 59.3, 57.3, 60.7, 58.7, 52.2, and 48.5%, and retention of GE was 78.8, 77.4, 79.9, 78.2, 74.6, and 70.6%, respectively. In conclusion, our experiment suggests that some tannin (up to 1.35% CE) is tolerated by growing broiler chicks without loss in nutrient utilization.

Key Words: Poultry, Sorghum, Tannin

702 Effects of tannins from different sorghums on nutrient utilization in broiler chicks. C. R. Monge*[1], J. D. Hancock[1], C. Feoli[1], R. C. Kaufman[1,2], M. R. Tuinstra[1], S. R. Bean[1,2], S. Beyer[1], and B. P. Ioerger[2], [1]*Kansas State University*, *Manhattan*, [2]*USDA/ARS*, *Manhattan, KS*.

A total of 96 broiler chicks (Cobb x Cobb, 7 d of age, and initial body weight of 128 g) was used in a 7-d metabolism experiment to determine the effects of tannin source on nutrient utilization. A reference diet with 50% cornstarch was formulated to meet or exceed the nutrient concentrations recommended in the 1994 NRC for poultry. Sorghum treatments were created by mixing endosperm (60% of the composite) from non-tannin sorghum (Mycogen 627) with blends of pericarp (40% of the composite) from the non-tannin and tannin sorghums (Koro Kollo, Sumac, and SC599). The pericarps were blended to provide 0.6 mg catechin equivalents/100 mg DM from each sorghum source. The sorghum treatments were substituted for cornstarch in the reference diet on a wt/wt basis. The birds were adjusted to treatment for 4 d followed by 3 d collection of excreta. The excreta were dried, ground, and analyzed for DM, N, and GE with Cr2O3 used as an indigestible marker. Compared to birds fed pericarp from Mycogen, birds fed the Koro Kollo treatment had less ($P < 0.05$) average daily gain (ADG). Birds fed pericarp from Mycogen had greater retention of DM ($P < 0.03$), N ($P < 0.02$), and GE ($P < 0.01$) compared to birds fed pericarp from Sumac and SC599. However, retention of DM, N, and GE were similar among birds fed pericarp from the different tannin sorghums with only a trend ($P < 0.09$) for greater GE retention in birds fed Koro Kollo rather than SC599. Means for Mycogen, Koro Kollo, Sumac, and SC599 were 27, 23, 27, and 26 g/d for ADG, 804, 779, 798, and 793 g/kg for G:F, 82, 78, 77, and 76% for retention of DM, 71, 67, 63, and 63% for retention of N, and 86, 82, 81, and 79% for retention of GE. In conclusion, pericarp from the various sorghums having tannins reduced nutrient utilization with only minor indication of differences in biological activity of the tannins from different sorghums.

Key Words: Sorghum, Tannins, Poultry

703 Quality characteristics of newly developed flaxseed: Chemical evaluation. B. A. Slominski*[1], T. Davie[1], A. Rogiewicz[1], W. Jia[1], C. M. Nyachoti[1], O. Jones[2], J. Dean[3], and P. Dribnenki[3], [1]*University of Manitoba*, *Winnipeg, Canada*, [2]*Canadian Bio-Systems*, *Calgary, Canada*, [3]*Agricore United*, *Winnipeg, Canada*.

Flaxseed is being widely used in laying hen nutrition for omega-3 enriched egg production and is currently being considered as a valuable source of fatty acids in swine and broiler chicken finishing rations. A comprehensive evaluation of the nutritive profiles of two newly developed yellow-seeded lines NuLin™ CR12 and NuLin™ CR50 in comparison with the conventional brown-seeded flax var. CBC Bethune was undertaken. On average, more oil ($P \leq 0.01$) was found in NuLin CR12 (47.8% DM) and NuLin CR50 (47.1% DM) than in the conventional flaxseed (43.9% DM). Even a higher magnitude of difference was noted for linolenic acid (omega-3) which, on seed basis, averaged 31.4 and 29.7% for NuLin CR12 and NuLin CR50, respectively, and was higher by 9-10 percentage points than that of Bethune (21.3% DM). Similar amounts of crude protein (23.5 and 21.6 vs 21.6% DM), sucrose (2.1 and 1.8 vs 1.9% DM), oligosaccharides (1.7 and 1.4 vs 1.8% DM), and phytate (1.3 and 1.0 vs 1.0% DM) were observed for NuLin CR12 and NuLin CR50 in comparison to Bethune. The yellow-seeded characteristic was reflected in the lower fiber content only for NuLin CR12 showing the mean total fiber value of 25.8% which differed significantly ($P \leq 0.001$) from that of NuLin

CR50 (32.0%) and Bethune (32.3%). On a fat free and DM basis, the total fiber content of NuLin CR12 and NuLin CR50 averaged 51.0 and 62.6%, respectively, and was followed by the same magnitude of difference (P≤0.001) in the content of lignin and polyphenols (9.2 vs 12.7%), glycoprotein (10.4 vs 16.1%) and ash (1.3 vs 2.8%). There was no difference in the non-starch polysaccharide (NSP) content between the two lines (30.2 vs 31.0%), although NuLin CR12 was lower (P≤0.001) in water-insoluble (15.8 vs 18.15%) and higher in water-soluble (i.e., mucilage) NSP (14.5 vs 12.9%). No major differences in essential amino acids and phytate and non-phytate P contents were observed among the samples.

Key Words: Yellow-seeded Flax, Chemical Composition, Omega-3

704 Evaluation of a dynamic model of calcium and phosphorus metabolism in layers. E. Kebreab*[1], J. Dijkstra[2], R. P. Kwakkel[2], and J. France[1], [1]*University of Guelph*, *Guelph, ON, Canada*, [2]*Wageningen University*, *Wageningen, The Netherlands*.

Phosphorus (P) is an essential nutrient involved in most metabolic processes of the body. Most of the interest in calcium (Ca) metabolism relates to eggshell formation. Although the eggshell is composed of calcium carbonate, metabolism of both Ca and P are closely related such that a deficiency in one can interfere with proper utilization of the other. Depending on time and availability, P can be mobilized in excess amounts in the laying hen which ends up being excreted in urine and contributes to build-up of P in the soil and water. Reduction and timing of P availability can mitigate pollution. To understand Ca and P metabolism properly, modeling can be of paramount importance. A new dynamic model of P and Ca metabolism in layers has been developed using ACSL to simulate diurnal changes in Ca and P and the layer's hourly requirement for those minerals. The model consists of 8 state variables representing Ca and P pools in the crop, stomachs, plasma and bone. The duodenum is represented as a zero pool in the model. An experiment that measured Ca and P uptake in layers fed different Ca levels during shell-forming days was used to compare with model simulations. The experiment showed that the percentage of Ca retained in body and egg decreased from 62.5 to 50.5% when the Ca in diet was increased. The model simulations were in agreement with the trend. Predictions were 63.2, 56.1 and 55.3% for low, medium and high Ca levels in the diet. The experimental results showed that P retention increased significantly from 11.5% at the lowest Ca inclusion level to 24.1% at the highest. The model also predicted an increase in P retention from 8.4 to 25.4% at lowest and highest level of Ca inclusions, respectively. The advantage of the model is that absorption and utilization (or excretion in urine) can be monitored on hourly basis and adjustments to the diet can be made based on the times where Ca is mobilized for eggshell formation. The model successfully showed how the availability of one mineral affects the utilization of the other and is a useful tool to evaluate feeding strategies aimed at reducing P excretion to the environment in poultry manure.

Key Words: Phosphorus, Pollution, Model

705 Impact of dietary available phosphorus levels on growth and tibia ash of male broilers to 21 d. L. A. Oden*[1], S. D. Frankenbach[2], N. Augspurger[2], and J. B. Carey[1], [1]*Texas A&M University*, *College Station, TX*, [2]*JBS United, Inc.*, *Sheridan, IN*.

An experiment was conducted to evaluate the available phosphorus requirement of contemporary male broilers through 21 days of age. The basal diet was estimated to have 0.15% available phosphorus. Six additional diets were formulated with incremental 0.05% increases in available phosphorus with 0.45% the highest level of available phosphorus. Supplemental available phosphorus was provided in the form of Potassium phosphate. Eight replicate pens of each of the seven diets were arranged in a randomized block design with fifteen birds per battery pen for a total of 840 birds. Pens of birds were group weighed on day 1. Feed and water were provided ad libitum. Mortalities were removed, weighed and recorded twice per day. At 21 days, individual bird weights were recorded and the right tibia was removed, weighed and frozen until analyzed for ash content. There were no differences in 21d body weight, feed consumption, mortality, feed:gain, tibia weight or tibia as a % of body weight among birds fed 0.35, 0.40 and 0.45% available phosphorus. Lower levels of phosphorus resulted in significant decreases in feed consumption, body weight, and tibia weight. Level of phosphorus below 0.35% resulted in significant increases in mortality and feed:gain. The lowest level of phosphorus did not support normal growth performance. Based on these data dietary levels of 0.35% available phosphorus appear adequate for 21d male broilers reared in battery pens.

Key Words: Available Phosphorus, Broilers, Tibia Ash

706 Apparent calcium and phosphorus retention with different levels and source of vitamin D. J. A. G. Brito[1], A. G. Bertechini[1], J. C. C. Carvalho[1], A. Geraldo[1], J. O. B. Sorbara*[2], and F. J. Piraces[2], [1]*Universidade Federal de Lavras, DZO*, *Lavras, MG, Brazil*, [2]*DSM Nutritional Products*, *Sao Paulo, SP, Brazil*.

Vitamin D is high related with calcium and phosphorus retention. A metabolism trial was performed with four levels of vitamin D (800; 1500; 3500 and 5500 IU/ton feed) provided by two source of vitamin D and an additional two treatments with 2000 IU of vitamin D3 plus 37,5 mg of 25(OH)D3/ton feed and 2000 IU of vitamin D3 plus 70 mg of 25(OH)D3/ton feed fed to 18-d-old broiler chicken. The feed was based on corn soybean meal with 500 FTU/ton feed. Three days of total excrete collection was performed on wire cage. The treatments had five replications with 15 birds per replications in a complete randomized design. Calcium and phosphorus intake and calcium and phosphorus excreted were determined. The apparent calcium and phosphorus retention was calculated (intake - excreted / intake x 100). No interaction was observed (P>.05) between vitamin D supplementation levels and vitamin source to apparent calcium retention (ACaR), apparent phosphorus retention (APR) and phosphorus excreted (PE). Comparing the treatments that received just one source of vitamin D with the treatments with both source of vitamin D showed a better apparent calcium and phosphorus retention for the treatments that received both source of vitamin D. And comparing the two treatments with both source of vitamin D showed a better apparent calcium retention and calcium excreted to the treatment with higher level of 25(OH)D3 .

Table 1. Apparent Ca and P retention and total Ca and P excreted.

Source	Level	ACaR	APR	CaE	PE
D3	20	57.8	63.0	1.55b	1.03
D3	37.5	58.4	62.5	1.53	1.04
D3	87.5	58.2	63.6	1.54	1.01
D3	137.5	59.1	63.3	1.49	1.01
Mean D3		58.4	63.1b	1.53	1.023b
25(OH)D3	20	59.3	63.3	1.48a	1.01
25(OH)D3	37.5	59.0	64.5	1.54	1.01
25(OH)D3	87.5	59.0	64.4	1.50	0.98
25(OH)D3	137.5	59.0	64.6	1.51	0.98
Mean 25(OH)D3		59.1	64.2a	1.51	0.995a
D3+25(OH)D3	50+37.5	58.8b	64.2	1.535b	1.00
D3+25(OH)D3	50+70	60.8a	65.7	1.465a	0.97
Mean D3+25(OH)D3		59.8a	64.9a	1.500	0.985a
Mean Factorial		58.7b	63.6b	1.518	1.009b

a, b=P<0.05

Key Words: Metabolism, Vitamin, Excretion

707 Differences in amino acid digestibility in soybeans processed by different methods. T. Shi[1,2], H. M. Edwards, Jr.[2], G. M. Pesti*[2], and R. I. Bakalli[2], [1]*Shandong Academy of Agricultural Sciences*, *Jinan, Shandong, China*, [2]*University of Georgia*, *Athens, GA, USA*.

Three samples were obtained to investigate the influence of soybean processing method on the chicks' response to phytase supplementation. Corn (53.61%), soybean meal (37.47%), & soybean oil (5.49%) based diets (with 0.1 % Cr2O3) were fed to 3 replicate pens of 10 broiler chicks each in battery brooders for 16 days. Solvent extracted, expeller or extruded soybean meals were substituted for 50% of the entire diet. On day 16, ileal contents were gently removed from the posterior two-thirds of the ileum. The samples were freeze dried and assayed for amino acids. Only LYS, MET, CYS, THR, TRP & ARG were included in these analyses. If the amino acids were considered separately (11 error degrees of freedom), only LYS digestibility appeared to be affected by phytase (p<0.006), and there was no significant source by phytase interaction (p>0.20). However, if the amino acids were considered together in one ANOVA (66 error degrees of freedom), there were clear differences in amino acid digestibilities (ARG=88.2±1.5, CYS=57.0±4.0, LYS=87.2±2.0, MET=82.0±2.9, THR=73.7±3.0, TRP=84.5±1.9, p<0.013) and a very significant source by phytase interaction (p<0.002). There were no significant differences in chick growth or feed utilization between chicks fed the three soybean meals.

Table 1. Avg. amino acid digestibility in 3 SBM's (LYS, MET, CYS, THR, TRP & ARG)

Phytase	Solvent	Expeller	Extruded
0	84.5±3.4	72.1±5.0	75.8±3.8
1200	74.3±5.3	82.0±5.3	81.6±4.6
Avg	79.4±2.6	78.1±3.2	78.7±2.3

Key Words: Amino Acids, Digestibility, Phytase

Production, Management & the Environment - Livestock and Poultry: Poultry Management, and Environment

708 Evaluation of hydrated lime as a litter treatment at three application rates for broiler chickens. J. P. Blake*, J. B. Hess, K. S. Macklin, and C. A. Wilson, *Auburn University*, *Auburn, AL*.

A total of 1120 commercial broiler chicks (Cobb X Ross) were randomized with 70 birds assigned to each of 16 environmental chambers (2.44 × 2.44 × 2.44 m). Birds were fed a corn-soybean meal starter (1.5 lbs/bird; 22% CP, 3087 kcal/kg), grower (3.0 lbs/bird; 20% CP, 3131 kcal/kg), finisher (4.0 lbs/bird; 17.5% CP, 3197 kcal/kg) and withdrawal (c.a. 3.0 lbs/bird; 16.5% CP, 3219 kcal/kg). Treatments comprised a control (CON) with no litter treatment and hydrated lime (HL) at a commercial application rate equivalent to 50, 100, or 150 lbs/1,000 ft2 of floor space with each treatment assigned to four chambers. New pine shavings (54.42 kg) were placed in each pen. Feed and water were provided ad libitum under 24 hrs continuous light. Birds and feed were weighed at 21, 42 and 49 d to determine growth and feed performance. Litter and air quality samples were obtained for analysis initially and on day 7, 14, 21, 28, 35, 42 and 49 of the experiment. Ammonia measurements were conducted using a closed container of specified dimension inverted over the litter bed and determined using a Drager CMS Analyzer equipped with a remote air sampling pump. No differences (P>0.05) in growth performance (body weight, feed consumption, or feed efficiency) occurred during the 49-d experimental period due to treatment. Litter pH for the HL treatments was significantly higher (P<0.05) through day 21 as compared to the CON. Initial pH of the litter on day 0 for CON and HL at the 50, 100, or 150 rates were 6.35, 12.45, 12.82, and 12.82, respectively. By day 21 pH measurements were 7.25, 8.92, 9.38, and 9.45 for the CON and HL at the 50, 100, and 150 rates, respectively. Afterwards, there were no differences in pH due to treatment. Results indicated no significant (P>0.05) changes in ammonia levels due to the HL treatments. Results indicate that the application of HL on clean shavings resulted in an initial increase in litter pH (c.a. 50% higher) that continued through day 21 (c.a. 21% higher). HL failed to support any reduction in ammonia volatilization. Litter sample analysis did not indicate an increase in the amount of nutrients retained due to treatment. Litter moisture increased from a low of 8.9% to 26.4% by day 49 with no differences between treatments.

Key Words: Hydrated Lime, Litter Treatment, Ammonia

709 Evaluation of Poultry Guard™ litter treatment at three application rates for broiler chickens. J. P. Blake*, J. B. Hess, K. S. Macklin, and C. A. Wilson, *Auburn University*, *Auburn, AL*.

For each of two experiments a total of 1120 commercial broiler chicks (Cobb × Ross) were randomized with 70 birds assigned to each of 16 environmental chambers (2.44 × 2.44 × 2.44 m). Birds were fed a corn-soybean meal starter (1.5 lbs/bird; 22% CP, 3087 kcal/kg), grower (3.0 lbs/bird; 20% CP, 3131 kcal/kg), finisher (4.0 lbs/bird; 17.5% CP, 3197 kcal/kg) and withdrawal (c.a. 3.0 lbs/bird; 16.5% CP, 3219 kcal/kg). Treatments comprised a control (CON) with no litter

treatment and Poultry Guard™ (PG) at a commercial application rate equivalent to 50, 100, or 150 lbs/1,000 ft^2 of floor space with each treatment assigned to four chambers. New pine shavings (54.42 kg) were placed in each pen. Feed and water were provided ad libitum under 24 hrs continuous light. Birds and feed were weighed at 21, 42 and 49 d to determine growth and feed performance. Litter and air quality samples were obtained for analysis initially and on day 7, 14, 21, 28, 35, 42 and 49 of the experiment. Ammonia measurements were conducted using a closed container of specified dimension inverted over the litter bed and determined using a Drager CMS Analyzer equipped with a remote air sampling pump. No differences ($P>0.05$) in growth performance (body weight, feed consumption, or feed efficiency) occurred during the 49-d experimental periods due to treatment. Litter pH was significantly lower ($P<0.05$) for PG treated pens as compared to CON and this effect continued at the 100 and 150 rates until termination of the experiments at 49-d. Overall reduction in pH as compared to the control ranged from approximately 5 to 65% and was dependant on level of application, bird age and other environmental influences. Results indicated that the PG treatments did not elicit a significant ($P>0.05$) reduction in ammonia in either experiment.

Key Words: Poultry Guard, Litter Treatment, Ammonia

710 Litter bacterial levels associated Poultry Guard™. K. S. Macklin*, J. P. Blake, J. B. Hess, and R. A. Norton, *Auburn University*, *Auburn, AL*.

Litter treatments are commonly applied to litter to reduce ammonia and bacterial levels. Two trials were performed in which the effects of Poultry Guard™ (PG) on litter bacterial counts, percent moisture and pH were measured. Both trials were performed using clean pine shaving litter that was placed into 16 environmental chambers (2.44 x 2.44 × 2.44 m). Chicks were placed at a density of 70 chicks/pen. In both experiments there were four treatments, with each treatment getting four pens. The treatments comprised of a control (CON) and (PG) being applied at 50, 100 and 150 lbs/1000ft^2. Both experiments had litter collected weekly from three areas within each pen for 7-weeks. Bacteriologically total aerobic, anaerobic, Staphylococcus, and C. perfringens levels (cfu/g) were determined. Also the presence or absence of Campylobacter and Salmonella was determined. Bacterial counts (CFU/g) and percent moisture data were transformed using log10 and arcsine transformations, respectively. The data was analyzed using GLM with $P<0.05$ and significant means were separated using Tukey's HSD. The results for the two trials showed that both the 100 and 150 lb application rates kept the pH lower then the CON and 50 lb rate until day 49. There was differences ($P<0.05$) in the moisture level between the treatments. The bacterial numbers between the two trials showed that there was no reduction in any of the numbers between the four treatments over the 7 weeks in which they were measured ($P<0.05$).

Key Words: Poultry Guard™, Litter, Bacteria

711 Pasteurization of chicken litter with steam and calcium oxide to reduce colonization and incidence of *Salmonella typhimurium*. M. Farnell*[1], A. Byrd[2], L. Sunkara[1], K. Stringfellow[1], P. Anderson[1], J. McReynolds[2], J. Carey[1], A. Bell[2], R. Stipanovic[2], and D. Caldwell[1], [1]*Texas A & M University*, *College Station*, [2]*USDA-ARS*, *College Station, TX*.

Commercial poultry are raised on absorbent bedding materials such as wood shavings or rice hulls. These materials are costly to remove and replace in an environmentally sound manner. Therefore, multiple flocks of chickens often are raised on the same bedding material for as long as 1 ½ to 10 years. Good management practices and decaking machines considerably extend the useful life of the bedding material. However, down time between flocks is only 5-14 days which does not allow a desired degree of pathogen reduction residual of the previous flock. As a consequence, day of hatch chicks with naïve immune systems are placed onto contaminated litter. These practices often result in costly infections from coccidia and other opportunistic pathogens. Additionally, foodborne pathogens such as *Salmonella* and *Campylobacter* survive in the litter to be transmitted from bird to bird and flock to flock via coprophagy or fomites. The nursery industry pasteurizes soil with steam to reduce plant pathogens. Another method adds calcium oxide to nursery soils to capitalize on the resulting exothermic reaction that occurs when the chemical interacts with water. These techniques are likely to reduce pathogens if used in commercial poultry houses. In this study, a steam sterilization cart simulated conditions used by the nursery industry to treat Salmonella typhimurium inoculated litter. Homogenized litter was exposed to steam for 0, 5, 30 or 120 minutes. Calcium oxide was used at concentrations of 0, 2.5, 5 or 10 %. Results showed that all treatments significantly reduced Salmonella typhimurium colonization by at least 3 orders of magnitude. However, most treatments reduced colonization levels to undetectable levels even when samples were enriched. These data demonstrate two novel techniques for reducing bacterial pathogens in poultry litter. Soil pasteurization potentially offers an environmentally sound means to reduce the pathogenic load and output of poultry waste.

Key Words: Chicken, Litter, Pasteurization

712 Evaluation of Envirobed® litter product for broiler production. R. M. Hulet* and T. L. Cravener, *The Pennsylvania State University*, *University Park*.

High quality litter products are essential for optimizing broiler efficiency and good health. Litter products must be able to absorb moisture, have low levels of mold and bacteria, allow efficient growth and development, and not damage skin or foot pads. Envirobed® is a "recycled-fiber" product made from chipped cardboard tubes with dust and fine particles removed. Broilers (864) were placed at a density of 14.35 birds/square meter into twenty-four pens containing either pine wood shavings (PS) or Envirobed® litter (E) at a depth of 5 cm. Birds were weighed at 0, 14, 28, and 42 days of age and feed consumption, conversion and percent mortality evaluated. At the end of the study, litter moisture and condition was evaluated. No statistical difference in body weight was found between birds grown on the PS (2.74 Kg) or E (2.70 Kg) litter by 42 days of age. PS reared birds at 14 and 28 d had greater body weight than the E reared birds. Overall feed intake was significantly less for birds on the E litter (4.78 kg) than for PS reared birds (4.93 kg). Therefore, feed conversion was significantly improved for the E reared birds (1.775) when compared to the PS reared birds (1.801) at the $P<0.054$ level. At forty-two days, percentage moisture for PS litter was significantly greater ($P<0.06$ level) than for the E litter (48 vs 43%, respectively). In Summary, Envirobed® was found

to be an acceptable litter product when compared to PS for rearing broilers to 42 days of age.

Key Words: Broiler, Litter, Growth

713 Use of ferric sulfate for ammonia reduction in commercial broiler houses. C. W. Ritz*[1], L. A. Harper[1], B. D. Fairchild[1], M. Czarick[1], J. Pavlicek[2], and V. Johnson[2], [1]*The University of Georgia*, [2]*Kemira Water Solutions*.

Ammonia concentration in poultry houses is a production issue of concern. Previous work has correlated negative bird performance with poor indoor air quality due to ammonia. Ventilation has been the key means of removing ammonia from poultry houses but the use of litter treatment products that lower pH are also commonly applied. Acid-based products, though effective for short-term ammonia reduction, have not proven to be long-term solutions to ammonia reduction due to the amount of product required to chemically bind ammonia, problems of application when birds are present, and the corrosiveness of the material. Consequently, new types of litter treatment are needed along with other mechanisms to reduce in-house ammonia concentrations and subsequent house emissions. The purpose of this study was to evaluate the effectiveness of a new litter amendment containing ferric sulfate compared to an alum-based litter amendment. Since alum is a commonly-used litter amendment in the broiler industry and at the request of the participating poultry company, in this study the alum treatment product was used as the Control and the ferric sulfate as the Treatment. Both Treatment and Control were applied at the same time and rate of 100 lbs per 1000 ft^2. Litter analyses for total nitrogen, ammonium nitrogen, nitrate nitrogen, percent moisture, pH, dry matter content, and soluble salts were taken throughout the study. Aerial ammonia concentrations were measured using time weighted detection tubes and gas-washing bottles. The ferric sulfate amendment was, on average, superior to the aluminum sulfate amendment in reducing ammonia concentrations in the houses during the first 10 to 12 days after bird placement, with mean ammonia concentrations for the ferric sulfate and alum at 13-19 ppm and 21-26 ppm, respectively. The ferric sulfate product improved retention of nitrogen in the litter over the control. No differences were noted in mortality, body weight, or feed efficiency between the two treatments.

Key Words: Ferric Sulfate, Ammonia, Broiler

714 Egg yolk and serum antibody titers, and manure nutrients of broiler breeder hens immunized with uricase or urease. Adrizal*[1], P. Patterson[2], and T. Cravener[2], [1]*University of Jambi*, *Jambi, Indonesia*, [2]*The Pennsylvania State University*, *University Park*.

This study evaluated if broiler breeder hens immunized with uricase, urease, or uricase+urease would develop IgY titers against these antigens to prevent manure-N degradation and NH_3 release. Hens (76, 43-wk, Ross × Arbor Acre) kept in individual cage were randomly assigned to PBS control, uricase, urease, or uricase+urease antigen. Hens were immunized with the antigens in the breast muscle i.m. on d 0, 7, and 14. Blood samples were drawn via the wing vein of 7 hens/treatment on d 0 (before injection), 4, 9, 12, 17, 21, and 24 for serum IgY titer analysis. Eggs were collected for 28 d for yolk IgY titer analysis. Manure samples were taken on d 0, 7, 14, 22, and 29 for solids, total-N, NH_4-N, organic-N, P, K, pH, and NH_3 measurements. Elevated egg yolk uricase-IgY titers were observed after the 2nd injection ($P \leq 0.0001$) and remained significantly higher than the PBS or urease treatment from d 9 to 24. An egg yolk urease-IgY titer was noticed after the 1st injection ($P \leq 0.01$), then undetectable for 13 d, and elevated again on d 17, 21, and 24 ($P \leq 0.0001$) beyond the control and uricase treatments. Serum uricase-IgY response was obvious ($P \leq 0.01$) after the 1st injection, highly significant by d 9, and remained greater than the PBS or urease treatment until d 28. The serum urease-IgY titer response lingered later in comparison with uricase-IgY. Only at 24 and 28 d were urease titers significantly greater than the PBS or uricase group. Hens immunized with uricase or urease responded well with both egg yolk and serum titers. Combination antigens were also significantly greater than the PBS controls, but less than the individual uricase or the urease. Manure NH_3 volatilization showed no clear relationship with the IgY titers. Only manure total-N concentration indicated greater N retention on d 29 from the uricase+urease combination (63.5 g/kg, DM basis) compared to the others ($P = 0.07$).

Key Words: Antibody Titer, Manure Nutrient, Broiler Breeder Hen

715 Dietary sodium bisulfate, humate and zeolite for broiler chickens: Impact on performance, litter nutrients and ammonia flux. P. Patterson*[1], T. Cravener[1], E. Wheeler[2], P. Topper[2], and D. Topper[2], [1]*Department of Poultry Science*, [2]*Department of Agricultural and Biological Engineering, The Pennsylvania State University*, *University Park*.

A broiler feeding trial was conducted to evaluate the effects of dietary Sodium bisulfate (S), Humate and Zeolite on growth performance, litter nutrients and litter ammonia flux. Cobb chicks (1728) were placed in 48 pens (0.0699 m^2/bird) with new pine shavings, and fed a commercial control diet from 0-14d. Six dietary treatments were fed from 14-44 days including a control, 0.75% S (S75), 0.50% S+0.75% Humate (S50H75), 0.50% S+1.0% Zeolite (S50Z100), 0.75% S+0.75% Humate (S75H75) and 0.75% S+1.0% Zeolite (S75Z100). Body weight (44d) was significantly higher for birds fed S75 (3.01 kg) vs. control (2.94 kg) or S50H75 (2.94 kg) diets. Feed intake to 44d was greatest for the S75Z100 vs. the other treatments, except S75H75 (P=0.0015). Overall FC was lowest for S75, highest for S50Z100 and S75Z100, and intermediate for the control and other treatments (P=0.0076). Mortality was unaffected by the dietary treatments and averaged 4.11%. Ammonia flux measures from the 23d litter (mg NH_3/m^2/min) were highest from the control litter, but linearly reduced by increasing levels of dietary S (P≤0.0001). The same trend was observed at 41d with S75 treatments averaging 4-fold less NH3 than the controls, and S50 treatments 35% less (P=0.0019). Litter pH was significantly reduced by dietary 0.75% S treatments compared to the control. Litter solids at 42d were significantly less (46.6%) for the S75 dietary treatments vs. the control and S50 treatments (mean 53.6%, P≤0.0001). On a DM basis litter Na (P≤0.0001), K (P=0.0004) and P (P=0.0286) were greater from dietary treatments with 0.75% S, and less from the control and 0.5% S treatment birds. Litter sulfur levels showed a linear trend with greater concentrations tied to greater dietary S levels (P≤0.0001). Overall, improvements in growth performance, and litter ammonia flux with the 0.75% S diet suggest promise for commercial application.

Key Words: Litter, Ammonia Flux, Broiler Performance

716 The potential for plants to trap emissions from farms with laying hens: 1. Ammonia. P. H. Patterson*[1], Adrizal[4], R. M. Hulet[1], and R. M. Bates[2], [1]*Department of Poultry Science*, [2]*Department of Horticulture*, [3]*Department of Agricultural and Biological Engineering, The Pennsylvania State University*, *University Park*, [4]*University of Jambi*, *Jambi, Indonesia*.

The potential of plant vegetation to trap ammonia (NH_3) discharged from a layer house through the exhaust fans was evaluated at the Pennsylvania State University Education Research Center in September 2005. Five tree species were planted in pot-in-pot containers in five rows downwind of the house fans, and in two control rows upwind of the hen house. Each row included one plant (upwind) or two plants (downwind) per species per row. When measured with a photoacoustic NH_3 detector at the same elevation as the fan (1.5 m), NH_3 concentration decreased sharply with greater distance, from 51.54 ppm at 0 m (at the fan) to 1.89 ppm at 5.5 m (between row 2 and 3), 0.27 ppm at 10 m (after row 5), and 0 ppm at 50 m (control). This trend was also observed with the dosi-tubes and photoacoustic detector at the 0.3 and 3.0 m elevations. Significantly lower NH_3 concentrations were recorded when the trees were present downwind of the fans compared to when the trees were removed (16.45^b vs. 19.35^a ppm) suggesting a portion of the atmospheric NH_3 was being held by the plants. This was further supported by a marked decrease in foliar N status of the plants with greater distance from the source. Plant species also differed with willow appearing to be the most responsive species and effective as an NH_3 trap.

Key Words: Plant, Ammonia, Foliage Nitrogen

717 The potential for plants to trap emissions from farms with laying hens: 2. Ammonia and dust. Adrizal*[1], P. Patterson[2], and M. Hulet[2], [1]*University of Jambi*, *Jambi, Indonesia*, [2]*Department of Poultry Science*, [3]*Department of Horticulture*, [4]*Department of Agricultural and Biololgical Engineering, The Pennsylvania State University*, *University Park*, [5]*Department of Natural Resource Ecology and Management, Iowa State University*, *Ames*.

The potential of plant vegetation to trap ammonia (NH_3) and dust (particulate matter [PM]) discharged from a layer house through the exhaust fans was evaluated at the PSU Poultry Education and Research Center in July 2006. Poultry and livestock NH_3 emissions are a concern for air quality, surface deposition, and animal and human health. PM is a human health concern as well and regulated by the US-EPA in non-attainment areas. Five tree species were planted in pot-in-pot containers in five rows downwind of four hen house fans and in two control rows upwind of the fans. When measured with a photoacoustic NH_3 detector at fan elevation (1.5 m), NH_3 concentrations decreased sharply ($P \leq 0.0001$) with greater distance, from 71.11 ppm at 0 m (at the fan) to 2.07 at 5.5 m (between row 2 and 3), 0.32 at 10 m (after row 5), and 0.07 ppm at 50 m (control). This trend was also observed with dosi-tubes and the photoacoustic detector at 0.3 and 3.0 m elevations. Significantly lower NH_3 concentrations were recorded in the presence of the trees compared to when the trees were removed at both 0.3 and 3.0 m elevations, suggesting a portion of the atmospheric NH_3 was being trapped by the plants. This was further supported by greater foliar N concentrations in plants when downwind of the fans ($P \leq 0.0001$). Dust concentrations sampled downwind of the fans were greatest at 2.5 m and decreased linearly to 50 m ($P \leq 0.0001$). Plant PM-2.5, 10 µm, and PM-total washed from the foliage showed the sample significant linear trend with greater distance from the fans. Plants also showed unique species differences in their capacity to trap and hold NH_3 and PM that can be applied in practical recommendations. In conclusion, these findings indicated vegetative buffers are capable of trapping NH_3 and PM fan emissions from poultry facilities.

Key Words: Plant, Ammonia, Dust

718 Vegetative buffers for fan emissions from poultry farms: ammonia, dust, and foliar nitrogen. R. M. Hulet*[1], Adrizal[1], P. H. Patterson[1], and C. A. B. Myers[2], [1]*The Pennsylvania State University*, *University Park*, [2]*Berks County Extension*, *Lebanon, PA*, [3]*Capital Region Extension*, *Lancaster, PA*, [4]*USDA-NRCS*, *Harrisburg, PA*, [5]*USDA-NRCS*, *Corning, NY*, [6]*Iowa State University*, *Ames*.

A study evaluated the potential of trees planted around commercial PA poultry farms to trap ammonia (NH3) and dust particulate matter (PM). Hybrid poplar (HP), hybrid willow (HW), Norway spruce (NS) and Streamco willow (SW) were planted in several rows downwind of the exhaust fans of one turkey, two layer, and two broiler farms (2003 to 2004) and sampled in 2006 for DM, nitrogen (N), and PM analysis. Concentrations of ammonia were passively measured downwind of exhaust fans (eight hours). Plant N levels did not differ among farms, but were significantly affected by distance from the fan ($P<0.001$), especially when comparing ammonia (ppm) at 0 m (12.01) with 11.4 m (2.59), 15 m (2.03), and 30 m (0.31). Farm type affected foliar DM ($P< 0.0001$) but not N. Both foliar DM and N were influenced by species ($P<0.0005$), where HP, HW and SW showed a greater response than NS. Location also affected foliar N with significantly higher values noted nearer the fans than the controls (3.19 vs. 2.71 %). Plant species had no effect on foliar PM at greater than PM10µm, but NS and HW trapped PM2.5µm, PM10µm and total PM significantly better than the other two species. The effect of location was seen only in PM >10µm, where the plants nearer fans held more total PM than controls (0.021 vs. 0.0005 mg cm-2). The capacity of plants to trap and benefit from ambient ammonia around commercial poultry farms and their potential as dust traps were observed in the present study and suggested the buffer's function to reduce farm emissions. HP, HW, and SW seemed to be appropriate plants to absorb aerial ammonia nitrogen whereas NS and HW appeared to be more effective dust traps.

Key Words: Vegetative Buffer, Ammonia Uptake, Plant Species

ARPAS Symposium: Current and Future On-Farm Auditing & Assessment

719 Animal welfare assessment and auditing. S. E. Curtis*, *University of Illinois*, *Urbana*.

The assessment and the auditing of animal welfare are related but distinct processes. An assessment protocol prescribes how the assessment will be accomplished in terms of indicators of animal state of being and their measurable goals. The auditing process aims to determine whether or not those goals have been achieved. Of course, an auditor must first assess, following the assessment protocol, to be able to determine that. The auditing process is the topic of another presentation in this symposium. Here the focus will be on the rational development of an assessment protocol. Several preliminary decisions have to be made as an approach to establishing an assessment protocol is set. In this author's opinion, the following guidelines should be followed: (1) The concept of animal welfare should be followed, not animal rights; (2) Objective criteria of evaluation should be employed, not subjective criteria; (3) An approach based on animal performance, not animal feelings, is favored; (4) The performance axiom, not the feelings axiom, is favored; (5) Animal-performance standards, not environmental-design standards, should rule; (6) Different goals for assessment —e. g., inter-herd comparison or intra-herd improvement—dictate different approaches; (7) Theoretical constructs often will still serve better than intuition (often flawed) or empirical data (not enough at hand); (8) Respective evaluation criteria should be subjected to weighting schemes as the final composite index of state of being is formulated (although developing such strategies is proving to be a difficult task); and (9) the mixed model of motivation should serve as the guide when developing a variable-weighting scheme.

Key Words: Assessing Animal Welfare

720 Auditing and assessing nutrient management for water quality. A. L. Sutton*, *Purdue University*, *West Lafayette, IN*.

Concentrated animal feeding operations (CAFO) and many mid-sized animal feeding operations (AFO) are required to comply with state and federal environmental regulations specifically related to the protection of water quality. Most current regulations are based on the need to account for and control nutrient flow on-farm to minimize buildup, leaching and runoff of nutrients that may pose a risk to surface and ground water quality. In addition, there is pressure for producers to control pathogens, antibiotics, hormones and endocrine disruptors in the waste stream, soils and water. Attempts to encourage best management practices to control nutrient flow include the requirements for nutrient management plans, comprehensive nutrient management plans, conservation practice plans, storm water pollution prevention plans, chemical and fuel handling, animal mortality management, and emergency action plans. The overall goal of the nutrient management plan on a livestock and poultry farm is to sustain as much as possible a whole farm nutrient mass balance while producing animal products efficiently and profitably. An extensive auditing and assessment program evaluates the status of nutrient management on-farm and develops an action plan specific for CAFO and AFO to minimize water pollution and sustain water quality standards. An annual audit and review checks the performance of the CAFO and AFO on environmental stewardship and identifies areas needing improvement. Critical control points that need to be audited and assessed for each farm are 1) nutrients imported on-farm, 2) nutrients exported off-farm, 3) nutrient status of soils and water, 4) manure handling and storage facilities, 5) conservation practices, 6) runoff waste water control, 7) land application practices, 8) animal mortality practices, 9) record keeping system, 10) operation and maintenance plan, and 11) alternative treatment systems, if applicable. Professionals involved currently and in the future that audit and assess nutrient management on-farm will be discussed including the role of animal scientists in this process.

Key Words: Nutrient Mass Balance, Animal Feeding Operations

721 Auditing and assessing nutrient management for air quality. N. A. Cole*[1], R. W. Todd[1], B. Auvermann[2], and D. B. Parker[3], [1]*USDA-ARS-CPRL*, *Bushland, TX*, [2]*Texas Agricultural Experiment Station*, *Amarillo*, [3]*West Texas A&M University*, *Canyon*.

The potential adverse effects of concentrated animal feeding operations (CAFO) on the environment are a growing concern. The air quality concerns of CAFO vary with the location, type of operation, and other factors. In general, those of most concern include ammonia, hydrogen sulfide, particulate matter (PM), volatile organic compounds (VOC), green house gases (GHG), and odors/odorants. Some states have initiated their own air quality regulations, in part because only PM and VOC are regulated under the Clean Air Act. However, in the future, ammonia and hydrogen sulfide may be regulated under the Superfund (CERCLA) and(or) "Right-to-Know" (EPCRA) Acts. The U.S. EPA and poultry, swine, and dairy industries recently agreed to the National Air Emissions Monitoring Study (Consent Agreement) to fund research on emissions of ammonia, hydrogen sulfide, PM, and VOC from U.S. production farms. Air quality regulations may be based on actual emissions, atmospheric concentrations, human perception (odors) or via limiting the size or location of CAFO. Measuring the concentrations or emissions of most air pollutants is expensive, complex, and labor intensive. Because of large spatial and temporal variability, concentrations and emissions must be measured continuously over an extended period of time. Because different methods/models can give widely varying results with the same data set, it is preferable to use a multitude of methods simultaneously and a mass balance should be run to assure emissions estimates are plausible. In the future, requirements for monitoring of air emissions from CAFO will probably vary from state to state and among different types of operations. Most likely, producers, and not the government, will be responsible for the costs of any air quality monitoring program. Processed-based and empirical models need to be developed so that emissions and(or) concentrations of air pollutants can be estimated from readily obtainable diet, animal, facility, and environmental variables. Auditors will need to be trained in a variety of disciplines including animal sciences, chemistry, engineering, micrometeorology, instrumentation, mathematical modeling, and logic.

Key Words: Air Quality, Regulation, CAFO

722 Training and certification of animal auditors. A. K. Baysinger*, *Farmland Foods*, *Bruning, NE*.

Animal auditing as a profession is in its infancy. Oversight of a profession that can and will have a significant impact to animal agriculture was the motivation to create the Professional Animal Auditor Certification Organization (PAACO). PAACO is an organization of

five animal industry organizations with extensive expertise on best management practices and current science in animal agriculture. The organization's purpose is to promote the humane treatment of animals through education and certification of animal auditors and to promote the profession of animal auditors. Founding and current organizations are the Federation of Animal Science Societies (FASS), American Registry of Professional Animal Scientists (ARPAS), American Association of Swine Veterinarians (AASV), American Association of Bovine Practitioners (AABP) and American Association of Avian Pathologists (AAAP). Website: www.animalauditor.org. PAACO does not create audits nor determine protocols within animal agriculture. Its role is to work with the species organization to train and certify auditors to the industry determined standards.

PAACO, Inc. Background

Successful livestock, dairy and poultry producers and their related industry partners provide sound animal care on commercial farms and harvest plants. Most animal and meat producer organizations have guidelines that are consistent with sound science and a consideration of economic realities. The process by which auditors are qualified, trained and certified continues to be developed by PAACO. Many groups require auditors and audit firms to have specific qualifications, experience and abilities. FASS, ARPAS, AABP, AAAP and AASV are professional, independent, science-based groups that have come together to initiate training and certification for on-farm and harvest plant auditors. PAACO has anticipated the need to evaluate, train and qualify candidates that want to pursue animal auditing as a career. Animal welfare is only the first of many aspects of livestock production to be audited at the farm level. It is in agricultures best interest to verify the qualifications of the potential auditors.

Key Words: PAACO, Audit, Welfare

Breeding and Genetics - Livestock and Poultry: Dairy Cattle III

723 Analysis of calving ease trait in Canadian Holsteins. A. Sewalem*[1,2], F. Miglior[1,2], G. Kistemaker[2], P. Sullvian[2], and B. Doormaal[2], [1]*Agriculture and Agri-Food Cananda*, *Guelph, Ontario, Canada*, [2]*Canadian Dairy Network*, *Guelph, Ontario, Canada*.

The aim of this study was to examine the level of calving ease trait across parities and to estimate genetic parameters in Canadian Holsteins. Data consisted of 271,789 cows from 11,283 herds sired by 2,276 sires. At time of calving the calving ease was recorded as unassisted or unobserved, easy pull, hard pull and surgery. The distribution of each score across parities was 61.38, 31.15, 7.21 and 0.26% for unassisted or unobserved, easy pull, hard pull and surgery, respectively. The statistical model included the fixed effects of herd-year-season, age at calving, sex of calf and the random effects of service sire and animal. A single trait animal model was used. The distribution of each category in the first parity were 49.16, 37.70, 12.84 and 0.30 % for unassisted or unobserved, easy pull, hard pull and surgery, respectively. The corresponding figures in the second parity are 64.53, 30.54, 4.81 and 0.13% and in the third parity 65.18, 29.92, 4.74 and 0.17%. The phenotypic correlations of calving ease trait for parity 1 and 2 was 0.21, for parity 1 and 3 0.17 and for parity 2 and 3 is 0.24. Heritability values from a single trait analysis (as trait of the dam) for parity 1, 2 and 3 were 0.096, 0.132 and 0.129, respectively. Estimation of genetic parameters using a multiple trait animal model is under progress.

Key Words: Calving Ease, Genetic Parameters, Canadian Dairy Breeds

724 Genetics of grass dry matter intake, energy balance and digestibility in Irish grazing dairy cows. D. P. Berry*, M. O'Donovan, and P. Dillon, *Moorepark Dairy Production Research Center*, *Fermoy, Co. Cork, Ireland*.

The objective of this study was to estimate genetic parameters for grass dry matter intake (DMI), energy balance (EB) and cow internal digestibility (ID) in grazing Holstein-Friesian dairy cows. Grass DMI was estimated up to four times per lactation on 1,588 lactations from 755 cows on two research farms in southern Ireland. Simultaneously measured milk production and body weight records were used to calculate EB. Cow ID, measured as the ratio of feed and faecal concentrations of the natural odd carbon-chain n-alkane pentatriacontane, was available on 583 lactations from 238 cows. Random regression and multi-trait animal models were used to estimate residual, additive genetic and permanent environmental (co)variances across lactation. Results were similar for both models. Heritability for DMI, EB, and ID across lactation varied from 0.10 (8 days in milk; DIM) to 0.30 (169 DIM), from 0.06 (29 DIM) to 0.29 (305 DIM), and from 0.08 (50 DIM) to 0.45 (305 DIM), respectively when estimated using the random regression model. Genetic correlations within each trait tended to decrease as the interval between time periods compared increased for DMI and EB while the correlations with ID in early lactation were weakest when measured mid-lactation. The lowest correlation between any two time periods was 0.10, -0.36 and -0.04 for DMI, EB and ID, respectively suggesting the impact of different genes at different stages of lactations which has repercussions for genetic selection. Eigenvalues and associated eigenfunctions of the additive genetic covariance matrix revealed considerable genetic variation among animals in the shape of the lactation profiles for DMI, EB and ID which may be exploited in breeding programs. Genetic parameters presented are the first estimates from dairy cows fed predominantly grazed grass and imply that genetic improvement in DMI, EB and ID in Holstein-Friesian cows fed predominantly grazed grass is possible.

Key Words: Grass Dry Matter Intake, Energy Balance, Genetics

725 Principal components approach for estimating heritability of mid-infrared spectrum in bovine milk. H. Soyeurt*[1,2], S. Tsuruta[3], I. Misztal[3], and N. Gengler[1,4], [1]*Gembloux Agricultural University*, *Gembloux, Belgium*, [2]*FRIA*, *Brussels, Belgium*, [3]*University of Georgia*, *Athens*, [4]*FNRS*, *Brussels, Belgium*.

Mid-Infrared spectrometry predicts the milk components (e.g., %fat, %protein) from spectral data reflecting the milk composition. The data included 9,663 test days on 1,937 cows in 1 to 12 parity recorded from April 2005 to May 2006. Each sample was scanned by MilkoScan FT6000 into 1,060 points. Due to the high dimension, principal components approach (PCA) was done to reduce the traits and indicated

that 48 principal components (PC) described 99.02% of information. These PC were analyzed by multi-trait REML using the canonical transformation. This analysis considered 2,850 first lactation records for 738 cows in 7 breeds from 26 herds. Effects included in the multi-trait model were herd*test date, lactation stage, permanent environmental and animal random effects. The estimates of the variances were back transformed to the initial scales. Heritabilities varied from 0.005% to 57.20% for the different pin numbers. Spectral regions with heritability greater than 5% were located between 1 to 181; 194 to 558 and 709 to 1,060 pin numbers. PCA involving points in those regions demonstrated that only 9 PC explained 99.23% of information. Mid-Infrared spectrum contains specific regions with substantial genetic information potentially useful for selecting improved milk quality directly on spectral data.

Key Words: Mid-Infrared, Milk, Heritability

726 Associations between body size, body condition score and fertility parameters in pasture-based seasonally calving commercial dairy herds in Australia. T. E. Stirling*[1], C. R. Stockdale[2], and K. L. Macmillan[1], [1]*The University of Melbourne*, *Werribee, Victoria, Australia*, [2]*Primary Industries Research Victoria*, *Kyabram, Victoria, Australia*.

The objective of this study was to evaluate the associations between body size parameters (hip height and hip width) with changes in body condition score (BCS), and the association with fertility parameters. A total of 1850 cows from 5 commercial pasture-based seasonally calving herds were monitored over a 12-month production cycle, with BCS assessed pre-calving, start of the artificial insemination period (SAIP), mid lactation and late lactation. Little variation was observed in height and width parameters; 140.0 ± 0.11cm and 43.0 ± 0.09cm respectively (mean ± standard error); but associations with BCS and fertility could be drawn. Taller cows tended to be thinner throughout the production cycle ($P<0.05$ pre-calving, SAIP and late lactation) while wider cows were fatter ($P<0.05$). Height was not related to the likelihood to become pregnant nor the interval between SAIP and conception (INT); however, width was positively correlated to the INT ($P<0.01$) meaning wider cows took longer to conceive. Body frame size (HxW) was not significantly related to BCS per se, apart from at SAIP when larger cows were fatter ($P<0.01$). Despite this, larger cows lost more condition in early lactation, were less likely to become pregnant, and those that did become pregnant had a longer INT. Cows with a greater height to width ratio (H:W) were thinner throughout the production cycle and did not have significant losses in condition in early lactation. These cows were more likely to become pregnant and those that did become pregnant had a shorter INT. The experiment was conducted during drought conditions when nutritional intake was limited and fertility compromised. Under these conditions, large cows were unable to maintain enough condition to optimise fertility. Despite being thinner overall, cows with greater H:W were able to maintain a more consistent BCS and had a better reproductive performance.

Key Words: Body Size, Body Condition Score, Fertility

727 Comparison of yield in Holsteins, Jerseys, and reciprocal crosses in the Virginia Polytechnic Institute and State University - Kentucky crossbreeding trial. B. G. Cassell*[1], K. M. Olson[1], and A. J. McAllister[2], [1]*Virginia Polytechnic Institute and State University*, *Blacksburg*, [2]*University of Kentucky*, *Lexington*.

Purebred Holstein and Jersey cows at Virginia Polytechnic Institute and State University and Kentucky were bred to four Holstein and four Jersey bulls in AI in a diallele scheme. First calvings to project animals were in June 2005 at Virginia Polytechnic Institute and State University and January 2006 at Kentucky. Here we summarize summit and peak yields and projected 305 day actual production from animals with at least 150 days in milk in first parity. Data include 33 HH (breed of sire first), 19 HJ, 17 JH, and 12 JJ animals. Breed comparisons were from a fixed model including four breed groups, seven herd-seasons of calving groups (five four-mo groups at Virginia Polytechnic Institute and State University and two at Kentucky), and regression of response variable on age at calving in mo. The three degrees of freedom for breed groups were also partitioned into additive effects of Holstein versus Jersey genes, maternal effects, and heterosis and fit with herd-season and regression on age at freshening. Limited JJ animals and unequal sire progeny distribution may affect results. We found significant ($P<0.05$ for all comparisons) effects for additive gene action and heterosis for summit milk, peak milk, and projected actual 305 day yields of milk, protein, and fat, but no significant maternal effects for any trait. Heterosis ranged from 8% for summit to 13% for peak yields, and exceeded 10% for 305d projected yields. Fixed effects were significant for all traits except age for summit yield and herd-season for protein yield. Summit yield differed only for Jerseys, while peak yield differed for Jerseys and JH vs. HH. Milk yields were higher for HH than HJ, JH, or JJ, but were not different from HJ or JH for protein. Milk, protein, and fat yields for Jerseys were lower than other breed groups, while HJ fat was higher than HH or JH. Entries in the table are in kg. Summit and peak refer to milk production while milk, protein, and fat refer projected 305d yields in kg.

Table 1. Breed group least squares means (kg) for summit and peak milk and for projected 305d yields of milk, protein, and fat

Breed	Summit	Peak	Milk	Protein	Fat
HH	34	37	9642	291	350
HJ	31	36	8915	293	383
JH	32	34	8963	288	360
JJ	24	25	6596	228	322

Key Words: Crossbreeding, Heterosis, Production

728 Quantitative Trait Loci affecting IgG serum protein levels, birth weight and gestation length in a Holstein x (Holstein x Jersey) backcross population. C. Maltecca*, K. A. Weigel, H. Khatib, and V. R. Schutzkus, *University of Wisconsin*, *Madison*.

Aim of the study was to identify QTL associated with stillbirth and calf survival, using data from a crossbred HOL x JER. experimental population consisting of 172 backcross calves created via backcross matings. Stillbirth is defined as a calf that dies just prior to, during, or within 24 to 48 h of parturition. The cost of stillbirths to the US dairy industry has been estimated to be ~$132 million per year. Nonetheless its binary nature and low frequency make it difficult to investigate. In the study three indicators of general health were utilized instead. The first, calf birth size, was considered in relation with the ability of the calf to survive and later perform. The second, Calf IgG absorption during the first 72h of life, is a strong indicator of passive immunization

attainment and it's associated with long-term calf performance. Finally, studies by Meyer et al. ranked gestation length as the third most important factor affecting stillbirth rates in primiparous cows with dystocia scores of 3+ and third for multiparous cows for any level of dystocia. The same author also reported a significant decrease in stillbirth for longer gestations. This trait was then chosen in connection with its influence on newborn survival. Calves were measured for weight after birth. Immune function was evaluated through serum IgG levels between 24 and 78h of age. Serum IgG levels were determined by radial immuno-diffusion assay. Gestation lengths were recorded as part of the routine data collection. Results from a genome scan, are discussed. 182 microsatellites were chosen among 270 after sires genotyping. Spacing between markers ranged from 3.4 to 32.85 cM with an average of 15.93 cM. Interval mapping analysis was performed for all traits considered. Evidences for suggestive QTL ($P<0.05$) for IgG levels were found in at least one of the families at CHR2 (~72 cM) and CHR5 (~88 cM). Evidence for a significant QTL (~$P<0.01$) for IgG level were found in CHR6 (~68 cM) in one family. Evidence for suggestive QTL ($P<0.05$) for birth weight were found in CHR2 (~24 cM) and CHR6 (~90 cM) in at least one family. Evidences for a suggestive QTL ($P<0.05$) affecting gestation length, were found in CHR9 (~100cM).

Key Words: QTL, Cattle, Health

729 Stearoyl-CoA desaturase gene polymorphism and milk production traits in Italian Holsteins. N. P. P. Macciotta*[1], M. Mele[2], G. Pagnacco[3], M. Cassandro[4], G. Conte[2], A. Cappio-Borlino[1], and P. L. Secchiari[2], [1]*Dipartimento di Scienze Zootecniche, Università di Sassari*, *Sassari, Italia*, [2]*Dipartimento di Agronomia e Gestione dell'Agro-Ecosistema, Università di Pisa*, *Pisa, Italia*, [3]*Dipartimento di Scienze e Tecnologie Veterinarie per la Sicurezza Alimentare, Università di Milano*, *Milano, Italia*, [4]*Dipartimento di Scienze Animali, Università di Padova*, *Padova, Italia*.

The Stearoyl-CoA desaturase (SCD) is a key enzyme for the lipid metabolism of ruminants, being able to introduce a double bond at the ÃƒÅ½Ã¢â‚¬Â9-position in a large spectrum of fatty acids. A polymorphism with two alleles (A and V) has been reported for the SCD locus in cattle, due to three single nucleotide polymorphisms that are in linkage disequilibrium. In this work, possible associations between SCD genotype and milk production traits in Italian Holsteins are investigated. Data were 5,097 test day records for milk, fat and protein yields, fat and protein contents, measured on 313 Italian Holsteins (2,2 lactations per cow). Data were analysed with a mixed linear model that included the fixed effects of herd, test date, genotype at the SCD locus, parity, lactation stage nested within SCD genotype and the random effect of the animal plus the random residual. Parity, test date, herd and lactation stage affected significantly milk production traits, except for parity on fat content. A statistically significant effect of the SCD genotype was observed for milk yield, fat content and protein yield. In particular, VV cows had an average daily milk yield higher than AV and AA cows (kg/day 35.95, 34.59, 33.71, respectively; $P<0.01$), a lower fat content (gr. fat/100 gr milk 3.39, 3.51, 3.55, respectively; $P<0.05$) and a higher protein yield (kg/day 35.95, 34.59, 33.71, respectively; $P<0.01$). Differences observed among the three different genotypes tend to remain constant throughout the whole lactation. Although observed in a limited sample of cows, these results, together with the recently reported influence of the SCD polymorphism on fatty acid composition of carcass and milk fat in cattle, seem to suggest a possible role of the SCD locus as a candidate gene to be used in the genetic improvement of milk production traits in cattle via schemes of Marker Assisted Selection.

Key Words: Stearoyl-CoA Desaturase, Polymorphism, Milk Production Traits

730 Effect of pregnancy on milk yield of Canadian dairy cattle. S. Loker*[1], J. Bohmanova[1], F. Miglior[2,3], M. Kelly[1], and G. Kistemaker[3], [1]*University of Guelph*, *Guelph, ON, Canada*, [2]*Agriculture and Agri-Food Canada*, *Sherbrooke, QC, Canada*, [3]*Canadian Dairy Network*, *Guelph, ON, Canada*.

Pregnancy has been reported to have a negative impact on milk production in dairy cattle. A suitable method for estimating the effects of pregnancy is required before pregnancy can be properly accounted for in genetic evaluations. In this study, two models were used to account for pregnancy in seven Canadian dairy breeds. The first model represented pregnancy effects with days open, studying the impact of increased days open on the shape of the lactation curve. The second model measured the impact of the stage of pregnancy on milk production. Milk production for cows with short days open tended to drop significantly in the last part of lactation, while cows with longer days open had proportionally higher milk yield. Using the second model, milk yield declined in all breeds in the study after 4 months of pregnancy (from -0.5 kg/d in first parity Jerseys to -1.3 kg/d in third parity Holsteins). While the pattern of decline in milk yield using both models generally followed the results of other studies, the effect of days open from the first model seemed to be confounded with the production level of the cows. Stage of pregnancy provided a more realistic estimate of the effect of pregnancy on milk production, especially when adjusted for stage of lactation.

Key Words: Pregnancy, Days Open, Genetic Evaluation

Dairy Foods: Products and Processing

731 Kinetics and properties of plant β-galactosidase extracted from durian seeds *(Durio zibethinus)* and its utilization on ice milk production. E. E. El Tanboly*, *National Research Center*, *Dokki, Cairo, Egypt*.

β-galactosidase (β-gal) was partially purified 2.16-fold with a total yield of 21.32% of the original activity by sequential use of ammonium sulfate precipitation and gel filtration through Sephadex G-200 from durian seeds *(Durio zibethinus)*. The β-gal activity was linear with time up to 20 min and still constant thereafter. A progressive increase in activity of the purified β-gal was observed up to 60°C accompanied by a decrease thereafter. An energy of activation of 3.04 Kcal/mole for the enzyme activity was derived from the Arrhenius plot. The purified β-gal started loosing activity above 40°C when incubated at different temperatures for 10 min and became completely inactivated at 80°C. The optimum pH was 3.0. Michaelis-constant (Km) value of 1.42 mM and a maximum velocity (Vmax) of 3.3 μmoles/ml/min. Fe+++, Zn++ and Cu++ strongly inhibited the enzyme. However, the enzyme was partially inhibited by Mg++, Ca++ and Mn++. The use of a plant β-gal in ice milk production was studied. Different concentrations of β-gal;

11.2 (TI), 22.4 (TII) and 33.6 (TIII) units/ml were added to fresh pasteurized milk., and a control with no β-gal. The results indicated that there is a direct of the increase of proportional of the increase of plant β-gal activity level to the level units to the hydrolyzed lactose, specific gravity and weight per gallon of ice milk. On the other hand, increasing β-gal decreased the overrun values. This can be attributed to the decrease in the amount of incorporation air. Organoleptic tests showed the highest value is recorded with TI (85.6%) this may be due to the increase in the sweet taste based on the hydrolysis of lactose by the β-gal, it could be said that the addition of β-gal to ice milk mixes increased the sweetness but properties of body and texture and appearance of the resultant ice milk slightly decrease.

Key Words: Durian fruit *(Durio zibethinus)*, β-galactosidase (β-gal), Ice Milk

732 Selenium supplementation of lactating dairy cows: effects on total selenium content and speciation in blood, milk and cheese. R. H. Phipps*[1], A. S. Grandison[1], A. K. Jones[1], D. T. Juniper[1], and G. Bertin[2], [1]*University of Reading*, *Reading*, [2]*Alltech (France)*, *Paris, France*.

Forty-multiparous Holstein cows were used in a 16-wk continuous design study to explore the effects of two selenium (Se) sources, (selenized yeast from *Saccharomyces cerevisiae* CNCM I-3060 Sel-Plex® and sodium selenite (Na_2SeO_3)) and inclusion rate of selenized yeast on Se concentration and speciation in blood, milk and cheese. Cows received ad libitum a TMR with 1:1 forage to concentrate ratio. The four diets (T1-T4) differed only in source and dose of Se additive. Estimated total dietary Se for T1 (no supplement), T2 (Na_2SeO_3) and T3 and T4 (selenized yeast) was 0.16, 0.30, 0.30 and 0.45 mg/kg DM, respectively. Whole blood and milk samples were measured at 28-d intervals. At each time point there were linear effects ($P < 0.001$) of selenized yeast on whole blood and milk Se concentration. At day 112 the whole blood and milk Se values for T1-T4 were 177, 208, 248, 279 ± 9.4 and 24, 38, 57, 72 ± 3.7 ng/g fresh material, respectively. Furthermore comparable doses of selenite and selenized yeast indicate improved Se bioavailability (T2: 38 vs. T3: 57 ng/g fresh material) from selenized yeast. In blood, selenocysteine (SeCys) was the main species and was not markedly effected by treatment, while in contrast, the inclusion of selenized yeast resulted in a marked increase in selenomethionine (SeMet) concentration. In milk, Se speciation showed that there were no marked treatment effects on SeCys content, while Se source had a marked effect on SeMet. At day 112 the SeMet content of milk from T3 was approximately three times higher (111 vs. 36 ng Se/g) than T2, and the level increased further to 157 ng Se/g for T4. At study end, milk from T1, T2 T3 was made into cheese (Caerphilly). Se source had a marked effect on total Se, SeMet and SeCys content of cheese. Replacing Na_2Se0_3 (T2) with selenized yeast (T3) increased the total Se, SeMet and SeCys content from 180 to 340 ng Se/g, 57 to 153 ng Se/g and 52 to 92 ng Se/g, respectively.

Key Words: Dairy Cows, Milk and Cheese, Selenium Speciation

733 Effects of temperature and membrane pore size on fractionation of caprine milk proteins in developing infant formula analogs. C. O. Maduko[1] and Y. W. Park*[2,1], [1]*University of Georgia*, *Athens*, [2]*Fort Valley State University*, *Fort Valley, GA*.

Denaturation of milk proteins during temperature treatment may cause a simultaneous change in permeate flux during subsequent membrane processing of the milk. Few studies have been reported on the modification of caprine milk proteins by membrane fractionation based on molecular size and temperature treatment to eliminate β-lactoglobulin (Lg) while retaining α-lactalbumin (La) for infant feeding. The study was conducted to examine effects of temperature treatment and membrane pore size on the elimination of β-Lg and retention of α-La, and subsequently determine these effects on the optimum permeate fractionation. Four batches (18.9 L each) of raw goat milk were collected, and 2 batches were pasteurized and immediately cooled to 4°C, and the other 2 batches were treated as raw milk. One batch of raw and pasteurized milks were frozen stored at -35°C for 2 days and the other batches were left at refrigeration (4°C). After separation of cream, all treated milk groups were underwent a two-step-cascade membrane separation by ultrafiltration to eliminate β-Lg from the whey fraction. The results showed that the frozen goat milk groups, either raw or pasteurized, showed the best membrane separation performance. The infant milk formula analog produced using the casein and optimum permeate (800/30kDa) fraction of these milk samples had the closest similarity to human milk with respect to the total protein content (1.3 g/100g), β-Lg content (1-2 %), and casein-lactalbumin ratio (0.6-0.7). Complete elimination of β-Lg in most permeate fractions of all 4 milk groups was observed, although the 800/30 kDa permeate fractions of frozen groups had small β-Lg content. It was concluded that membrane performance during ultrafiltration of caprine milk were affected by temperature treatment of the milk prior to membrane separation.

Key Words: Goat Milk Infant Formula, Ultrafiltration, β-lacto-globulin

734 The effect of dry period duration and dietary energy density in early lactation on the rennet gelation properties of milk. S. T. Butler*, M. de Feu, B. O' Brien, and J. J. Murphy, *Teagasc Moorepark DPRC*, *Co Cork, Ireland*.

This study was carried out to examine the effects of omitting the dry period and altering the energy density of the diet during early lactation on the rheological characteristics of milk. Forty mature Holstein-Friesian cows were used in a completely randomized design with a 2×2 factorial arrangement of treatments. Cows were randomly assigned to one of two dry period treatments (no planned dry period or standard 8 week dry period) and one of two nutritional treatments in early lactation (standard energy TMR or high energy TMR). Milk samples were collected at 2, 6 and 10 weeks postpartum. The concentration of fat, protein and lactose was determined in each sample. The rennet gelation properties were measured at 31° C using dynamic low-amplitude strain oscillatory rheometry. The elastic shear modulus, G′, was used as an index of gel firmness. Gelation time (GT; time taken for G′ to reach a value ≥ 0.2 Pa), maximum curd firming rate (CFR_{max}; maximum slope of the G′-time curve), and gel strength (GS; G′ value at 50 minutes) were calculated. Data were analysed as a factorial design using the MIXED procedure of SAS. Protein concentration was increased by omitting the dry period (31.8 vs. 34.7 g/kg; $P < 0.001$), but not by increasing diet energy density (32.9 vs. 33.7 g/kg; $P = 0.2$). Fat concentration was not affected by duration of the dry period (39.3 vs. 41.5 g/kg; $P = 0.1$), but was significantly reduced by increasing dietary energy density (43.1 vs. 37.7 g/kg; $P < 0.001$). GT was not affected by either dry period duration or diet. Omitting the dry period increased CFR_{max} (2.58 vs. 3.60 Pa/min;

P < 0.001) and GS (69.4 vs. 90.5 Pa; P = 0.003), whereas dietary energy density did not have an effect on either measurement. GS was correlated with CFR_{max} (r = 0.98; P < 0.001), and both variables were correlated with milk protein concentration (r = 0.71; P < 0.001, and r = 0.73; P < 0.001, respectively). The results indicate that omission of the dry period significantly increased milk protein concentration and improved the rennet gelation properties of milk, but that dietary energy density had little effect.

Key Words: Milk Processability, Dry Period, Rheology

735 Rheological properties of rennet gels prepared with milk protein concentrates. M. A. Ferrer*[1,2], A. R. Hill[2], and M. Corredig[2], [1]*University of Zulia*, *Maracaibo, Venezuela*, [2]*University of Guelph*, *Ontario, Canada*.

Milk protein concentrates (**MPC**) are value-added ingredients prepared by membrane filtration commonly employed in dairy processing. To understand the factors affecting the rheological behaviour of rennet-induced gels containing MPC, MPC (56%, 70% and 90% protein) dispersions were prepared in water at a final concentration of 5% protein and their gelation behaviour was tested using a controlled stress rheometer. The calcium to protein ratio and the soluble calcium were inversely proportional ($p<0.05$) to the amount of protein present in the MPC powders. The amount of casein-macropeptide (**CMP**) released during the enzymatic reaction was determined by RP-HPLC. The maximum amount of CMP released from the micelles was lower in MPC 90 and MPC 70 compared to MPC 56 and skim milk powder. These results can be explained by SDS-PAGE data that showed more κ-casein in the soluble phase of MPC90, and therefore less remaining in association with the micelles, relative to MPC 56 and skim milk. Because calcium plays a major role in rennet-induced gelation of casein micelles, we also studied gelation behaviour of MPC dispersions equilibrated to their original environment by extensive dialysis against milk. In all cases, when more free calcium was present in the dispersions, dialysis dramatically extended the gelation time and decreased the stiffness of the gels. It was also shown that dialysis of MPC dispersions against milk significantly increased the amount of non-micellar casein in the dispersions. These results indicate that the equilibrium between the soluble and insoluble ions is the determining factor affecting the renneting functionality of casein particles present in MPC.

Key Words: Milk Protein Concentrate, Rennet Gel, Ionic Equilibrium

736 Rheological properties of whey protein dispersions in the presence of exopolysaccharides from *Lactococcus lactis* ssp. *cremoris*. I. Ayala Hernandez*[1], A. N. Hassan[2], and M. Corredig[1], [1]*University of Guelph*, *Ontario, Canada*, [2]*South Dakota State University*, *Brookings*.

Exopolysaccharides (EPS) produced by some strains of lactic acid bacteria improve textural properties and increase water retention in fermented dairy products. The aim of this research was to study the characteristics of EPS produced by *Lactococcus lactis* ssp. *cremoris*, and to better understand how those polysaccharides interact with proteins in milk under different conditions. A highly ropy strain of *Lactococcus lactis* ssp. *cremoris*. (JFR1) was selected for this research, and fermentations were conducted in ultrafiltation (UF) permeate with and without added whey proteins at 30°C under controlled pH and different fermentation times. The highest degree of ropiness and viscosity increase was obtained at pH values between 5.8 and 5.5 after 22 hrs of fermentation, and a significant loss of ropiness was observed after prolonged incubation. Rheological tests performed on the different fermented permeates confirmed the increase of viscosity correlated with the observed increase in ropiness. The molecular weights of the EPS obtained (determined by HPLC-MALS) are affected by the pH and the duration of the fermentation. A novel scanning electron microscopy technique confirmed whey protein-EPS interactions. This method covalently links milk proteins to the observation surface so that any non-interacting material can be washed out, and only interacting components are observed. Comparisons of fermentations performed with non-EPS producing strains on media with the same protein content helped to confirm the importance of the interaction of the polysaccharide with the protein to generate the viscosity increase. The results of this work suggest that the impact of EPS on the textural properties (ropiness and increased viscosity) of fermented products is determined not only by its molecular weight but also by its ability to interact with milk proteins.

Key Words: Whey Proteins, *Lactococcus lactis*, Exopolysaccharides

737 The impact of preacidification of milk and fermentation time on the properties of yogurt type gel. Y. Peng*[1], D. S. Horne[2], and J. A. Lucey[1], [1]*University of Wisconsin*, *Madison*, [2]*Formerly of Hannah Research Institute*, *Ayr, Scotland*.

The textural properties of yogurt are determined by the nature and type of casein interactions. To understand how the amount of insoluble Ca (CCP) associated with casein particles and fermentation time influence yogurt gels, we used a central composite experimental design and varied the initial milk pH and fermentation time (from the initial milk pH to 4.6). We hypothesized that varying the initial milk pH altered the amount of CCP and varying the fermentation time influenced the rate and extent of solubilization of CCP during the gelation process. Both of these factors could influence casein interactions and thereby alter gel properties. Milks were preacidified to pH values from 6.55 to 5.65 using glucono-δ-lactone and equilibrated for 4 h at 40°C before inoculation. Fermentation time was varied from 250 to 500 min by adding various amount of culture at 40°C. Gelation properties were monitored using dynamic oscillatory rheology. Microstructure was studied using fluorescence microscopy. Whey separation was analyzed at pH 4.6. The initial pH value of preacidification strongly affected the solubilization of CCP ($P<0.0001$). Storage modulus values at pH 4.6 were positively influenced by initial pH and negatively affected by fermentation time. Loss tangent maximum during gelation was positively affected by initial milk pH. Fermentation time positively affected whey separation ($P<0.0001$). Fermentation time significantly influenced the rate of CCP dissolution during fermentation as CCP dissolution was a slow process. Longer time resulted in greater loss of CCP at the pH of gelation. At the end of fermentation (pH ~4.6) virtually all CCP was dissolved. Preacidification of milk increased the solubilization of CCP, increased the loss of CCP crosslinks, and produced weak gels that had low storage modulus values. Long fermentation time allowed more time for solubilization of CCP during the critical gelation stage of the process and increased the possibility of greater casein rearrangements; both could have contributed to the increase in whey separation.

Key Words: Yogurt, Gelation, Whey Separation

738 The role of functional ingredients in marinated meat and poultry. B. S. Smith*, *John R. White Company, Inc.*, *Birmingham, AL*.

Traditionally, meat and poultry marinades have been used to convey a mixture of ingredients, through soaking, massaging, tumbling or injecting, in an effort to influence flavor, texture or other sensory attributes. Adding functional ingredients to a marinade can further influence product yield, cook loss, oxidative and microbial stability, and operational efficiency. Functional ingredient classes may include salts, sweeteners, phosphates, starches, gums and other hydrocolloids, and non-meat proteins. Many ingredients perform multiple functions when properly selected and incorporated through marinating. For example, aside from their contribution to flavor, ingredients like sodium chloride, sugars, and sodium or potassium lactate chemically bind water and effectively reduce water activity, which may positively influence shelf life. The combination of sodium chloride with phosphate enhances water holding capacity of the meat system by aiding muscle protein extraction, positively impacting yield and product texture, and minimizing package purge and cooking losses. Phosphates also have chelating properties that effectively reduce oxidation and warmed over flavor. Certain sweeteners participate in maillard browning to enhance product flavor and appearance. Starches, gums and other hydrocolloids effectively manage moisture to improve yield, manipulate texture, and minimize purge. Non-meat proteins also control moisture, but often are formulated to replace meat for economic purposes. Certain non-meat proteins may also contribute to marinade viscosity, which can influence absorption and retention. Freeze-thaw stability can be manipulated by the addition of certain sugars and modified starches. Water, while typically the transport medium for other ingredients in a marinade, can impact the efficacy of certain other functional ingredients. Chilling and softening source water for marinades can provide significant benefits in minimizing oxidation and improving protein extraction. In conclusion, proper ingredient selection, inclusion level, order of addition, and an understanding of functional properties and limitations are critical to success of the finished product.

Key Words: Functional, Ingredients, Marinade

739 Maximizing carcass characteristics of grass- and grain-fed Bonsmara steers using electrical stimulation. K. R. Hawks*[1], R. K. Miller[1], T. D. A. Forbes[2], F. M. Rouquette, Jr.[3], J. W. Holloway[2], and B. G. Warrington[2], [1]*Texas A&M University*, *College Station*, [2]*Texas Agricultural Experiment Station Uvalde*, *Uvalde*, [3]*Texas Agricultural Experiment Station Overton*, *Overton*.

Grass-based beef production systems have increased as market alternatives for beef. The effects of location, forage type, supplementation, limited grain feeding and electrical stimulation (ES) on subsequent carcass characteristics and fatty acid composition have not been fully elucidated. Our objectives were to identify the effects of location, forage type (warm v cool season), supplementation (S), harvesting steers immediately off forage or after 90 d on a high grain feedlot ration, and ES on USDA Quality and Yield grade characteristics, fat and lean color, pH and fatty acid composition in Bonsmara steers. Steers (n=48) were randomly assigned to pasture at Overton or Uvalde, TX. Eight steers were assigned to one of six treatments: Cool-season forage (CSF) at Uvalde and harvested off grass; CSF at Uvalde and harvested after 90 d on a feedlot ration; CSF at Overton and harvested off grass; CSF at Overton and harvested after 90 d on a feedlot ration; warm season forage (WSF) at Overton and harvested off grass; and WSF at Overton and harvested after 90 d on a feedlot ration. Within a treatment, four steers were given S (corn at 0.8% of BW/d) during forage feeding. After harvest, steers were ES (300 V for 30s, 350 V for 30s, 350V for 30s with 10s rest cycles) and chilled for 48 h. USDA Quality and Yield grade factors, meat and fat color, pH and fatty acid composition were determined. Steers harvested off grass had younger bone maturity, higher lean maturity, less marbling, higher pH, darker colored lean and fat, softer, coarser lean, lighter hot carcass weights and lower yield grades than steers harvested after 90 d on a feedlot ration regardless of location ($P>0.01$). Treatment by S interactions for lean firmness ($P=0.046$) and fat thickness ($P>0.01$) were observed. Lean maturity, heat ring, lean color and marbling were improved by ES ($P>0.05$). ES carcasses from S steers had lighter subjective lean color than carcasses from non-supplemented non-ES steers (5.0 v 4.5) ($P>0.05$). Fatty acid composition was influenced by treatment ($P>0.05$).

Key Words: Forage, Carcass, Cattle

740 A novel technique to assess internal body fat using real–time ultrasound. F. R. B. Ribeiro*[1], L. O. Tedeschi[1], J. Stoffer[2], and G. E. Carstens[1], [1]*Texas A&M University*, *College Station*, [2]*Cornell University*, *Ithaca, NY*.

The objective of this study was to develop a method to quantify internal fat composition of growing calves using real–time ultrasound (**RTU**) of KPH fat depth or linear measurement of KPH fat depth at. Data for this study were obtained from 56 animals (24 steers, 16 heifers, and 16 bulls) from two trials. Trial 1 was composed of Angus steers (n = 24) and Trial 2 had Angus bulls (n = 16) and Heifers (n = 16). Ultrasound KPH images were collected between the first lumbar and the 13th rib and KPH depth was measured between the ventral part of the *Psosa major* muscle and the end of the KPH fat 7 days pre-slaughter to measure the depth of KPH (**uKPHd**). Whole KPH and gastrointestinal tract (**GIT**) were removed from the hot carcass. Whole GIT was dissected and total internal fat (**IF**) was physically separated. Bulls were heavier than heifers and steers (479.87, 354.02, and 392.7 kg, respectively). Heifers had more KPH and total IF than bulls and steers (8.7 and 33.27, 7.18 and 28.35, and 7.50 and 28.94 kg, respectively). Carcass KPH depth (**cKPHd**) was predicted from uKPH with an R^2 of 0.87. Predictions of KPH weight using uKPHd had an R^2 of 0.81. Predictions of total IF using uKPHd had an R^2 of 0.81 whereas using cKPHd had an R^2 of 0.89. Our results showed that cKPHd can be predicted from uKPHd. Results also indicated that cKPHd can precisely predict total IF and that uKPH is a measurement just as precise as cKPHd to predict IF. The ability to measure total IF with a non–invasive and cheaper technique could greatly increase our ability to measure this trait in live animals at different points of the growing and finishing phase. More research is needed to evaluate the system for different diets, stages of growth, and breeds.

Key Words: Ultrasound, Internal Fat, Non-Invasive

741 Proteomic analysis of whole muscle fingerprints from yellow perch, (*Perca flavescens*), and identification of proteins associated with body weight and length. J. M. Reddish*, K. B. Green-Church, A. D. Nichols, N. S. St-Pierre, and M. Wick, *The Ohio State University*, *Columbus*.

A challenge of commercial aquaculture is to accelerate growth and increase muscle mass by genetic selection which will lead to higher harvest yields and increased profitability. Increased growth rate of yellow perch can be achieved through genetic selection; however, the concomitant changes in gene expression related to increased muscle growth in fish are not fully understood. Gaining an understanding of the molecular mechanisms of muscle development in fish species will have considerable economic value and may prevent meat quality problems due to selection in fish that have occurred in other animals of agricultural importance such as PSE in swine and poultry. Our hypothesis is that altered gene expression in muscle results in variability in body weight and length in fish and that the differential protein expression associated with the growth of fish muscle can be identified using electrophoretic, statistical and protein sequencing technologies. Our objective is to apply this proteomic technology to identify the gene products unique to enhanced muscle growth in pond-cultured yellow perch. Yellow perch muscle was sampled (n = 70) and body weight and length were recorded. Proteins were resolved by SDS-PAGE on 5 to 20 % gradient gels, stained with SYPRO Ruby® and analyzed using TotalLab™ image analysis software. Individual band percentages were independently analyzed using stepwise linear regression in SAS v.9.1 against body weight and length. Eight bands were associated with body weight (R^2 = 0.84) and nine bands were associated with length (R^2 = 0.85); four bands were common to body weight and length. Detection by MALDI-TOF-MS of peptides significantly associated with body weight and length identified forty-eight individual proteins or protein isoforms This information will be used to help identify genes which are uniquely associated with enhanced muscle growth in pond-cultured yellow perch.

Key Words: Yellow Perch, Muscle, Proteomics

742 Production and evaluation of a value-added turkey product using mechanically separated turkey meat. S. Williams*, N. Djeri, M. Balaban, and A. Ruiz, *University of Florida*, *Gainesville*.

The objectives of this research were to 1) manufacture a turkey product utilizing mechanically separated turkey meat (MSTM) as the chief ingredient, 2) determine the appropriate thermal processing conditions for cooking the canned product and 3) determine sensory and chemical characteristics, and microbial content of the finished product. Frozen 18.2 kg blocks of MSTM were purchased from a Virginia turkey processor and used to manufacture the product. The MSTM (83%) was blended with 17 % nonmeat ingredients (soy protein concentrate, water and seasonings). The meat mixture was stuffed into fibrous casings and cooked to an internal temperature of 71.1°C. The cooked sausage was cut into 681 gram portions, packaged in 0.91 kg capacity metal cans and retorted at 123.0°C for 2 hours or 112.8°C for 3.2 hours. The average protein and fat contents of the finished products were 15.0% and 19.4%, respectively. Sensory evaluation of the product revealed no significant differences (P > 0.05) in texture and flavor. However, 20% of the panelists commented that the product processed at 123.0°C for 2 hours had a "slightly softer texture" than the product processed at 112.8°C for 3 hours. The color of the product processed at 123.0°C was rated lower (P < 0.05) than the product processed at 112.8°C. The product yield, proximate composition and pH values were similar (P > 0.05) for both cooking processes. No microbial growth was detected in the finished canned products. As a result of this study, the canned turkey product is currently being shipped to Jeremie, Haiti for evaluation by the Haitian Health Foundation for utilization in their feeding program for children ages 6 months to 3 years old living in remote villages.

Key Words: Mechanically Separated Turkey Meat, Product Development, Turkey Product

743 Impact of early deboning and portioning on tenderness of vertically portioned broiler breast fillets. C. M. Owens*, S. C. Purcell, A. Saha, and J. F. Meullenet, *University of Arkansas*, *Fayetteville*.

Uniformity of boneless breast fillets is a highly desired aspect in the food service industry. In order to accommodate the demand for uniform product, poultry producers portion breast fillets to achieve the perfect size and shape. Tenderness is also an important consumer issue and early deboning can often result in decreased tenderness. Portioning fillets early postmortem may also negatively impact meat tenderness. The purpose of this study was to determine the effect of time of portioning and genetic strain on tenderness of vertically portioned breast fillets. One hundred twenty, six-week-old broilers from two commercial high yielding broiler strains were processed via an in-line system and then chilled with a two-stage method in 3 replications. Broiler carcasses were deboned at 2h or 4h postmortem (PM). Boneless breast fillets were vertically portioned at time of deboning (2h or 4h PM) or at 24h PM (i.e., after aging of deboned breast fillet) using a heart-shaped standard template removing cranial and caudal fractions. All fillets were cooked 48h PM to an internal temperature of 76°C and sheared using the MORS method, recording total energy (TE). Whole fillets used in this study were similar in weight (approximately 315 g) and all were portioned to approximately 75% of the original weight. Fillets deboned at 2h PM had significantly higher TE than those deboned at 4 h PM, indicating decreased tenderness as a result of early deboning. Portioning with a vertical cut further impacted meat tenderness as indicated by significantly higher TE in those portioned at time of deboning compared to those portioned at 24h PM (P<0.05). However, this effect was predominantly observed in those fillets deboned at 2h rather than at 4 h. Strain had little impact (Strain, P=0.1016; Strain × Debone, P=0.0570) on meat tenderness of portioned fillets. The results of this study suggest portioning with vertical cuts early postmortem can decrease meat tenderness to a greater degree than deboning alone. Processing procedures (e.g., deboning and portioning) had a greater impact on tenderness than the effect of commercial strain.

Key Words: Tenderness, Portioning, Broiler

744 Carcass and meat quality traits of Angus-cross steers finished on three different winter annual forages. C. R. Kerth*, K. W. Braden, and B. S. Wilborn, *Auburn University*, *Auburn, AL*.

Angus-cross steers (n = 18) were randomly assigned to one of three forages during an 84-d finishing phase. Ryegrass (*Lolium perenne*), rye (*Secale cereale*) and oats (*Avena sativa*) were compared with replicate 1.42-ha paddocks (2 paddocks per forage) established and stocked

with three steers (374 kg ± 6.43 initial BW) per paddock. All steers had access to salt and minerals free-choice. Grazing was initiated on Jan 19, 2006, when average forage mass reached 1000kg ha^{-1} as the first of two replicate years. When forage quality could no longer sustain growth, cattle were transported 50 km to the Auburn University Lambert-Powell Meat Laboratory and humanely harvested. Carcass data, pH, lean and fat color was measured 48 h postmortem and a boneless ribeye roll was removed from each carcass, vacuum-packaged, and stored (4C) until 21 d postmortem. Steaks were removed from the posterior end of the ribeye roll, overwrapped in PVC film and stored under simulated retail conditions for 7 d. Lean color was measured daily on each steak to monitor L*, a*, and b* values. Average daily gain was not affected (P > 0.10) by forage treatment. Type of forage did not affect (P > 0.50) HCW, preliminary yield grade, KPH fat%, LM area, maturity, marbling, final yield grade or final quality grade. Carcasses from steers finished on rye tended (P = 0.08) to have lighter (higher L* values) subcutaneous fat color compared to carcass from steers finished on either ryegrass or oats. Subcutaneous fat redness and yellowness and lean lightness, redness, and yellowness did not differ (P > 0.24) among the three forage treatments. Lean lightness (L*) and redness (a*) decreased (P < 0.05) with increasing days of retail display. The type of forage used to finish steers did not (P > 0.05) affect color traits of steaks under retail display. Type of forage used to finish Angus-cross steers does not affect carcass or meat color traits.

Key Words: Forage-Fed, Beef, Carcass

745 Impact of litter size and birth weight on growth performance, carcass characteristics, and meat quality in pigs. J. Bérard[1], M. Kreuzer[2], and G. Bee*[1], [1]*Agroscope Liebefeld-Posieux, Research Station ALP*, *Posieux, Switzerland*, [2]*ETH Zurich, Institute of Animal Science*, *Zurich, Switzerland*.

There is some evidence that within litter low birth weight (**Btw**) pigs not only grow slower and have fatter carcasses but also meat quality traits are impaired compared to their high Btw siblings. Because the variability of the Btw is greater in large compared to small litters, the aim of this study was to test the hypothesis that effects of Btw on growth performance, carcass characteristics, and meat quality in the LM and the light portion of the semitendinosus muscle (**ST**) are different when pigs originate from small or large litters. The 60 Swiss Large White barrows used originated from 20 litters with either less than 10 (**S**) or more than 14 (**L**) piglets born per litter. Within each litter, the lightest (**L-Btw**), the heaviest (**H-Btw**), and the barrows with a Btw nearest to the average Btw of the litter (**M-Btw**) were selected. At weaning the barrows were individually penned and had free access to the diet until slaughter at 105 kg BW. The Btw of L- as compared to S-litters were lower in L-Btw (1.2 vs. 1.6 kg) and M-Btw barrows (1.6 vs. 1.9 kg) and similar in H-Btw barrows (1.9 vs. 2.0 kg) (litter size × Btw interaction; $P < 0.01$). The L-Btw barrows grew slower (0.81 vs. 0.90 kg; $P < 0.01$), ingested less feed (2.30 vs. 2.42 kg; $P = 0.03$), and were still less efficient (2.84 vs. 2.71 kg feed/kg gain; $P < 0.01$) than H-Btw- and M-Btw barrows, regardless whether they originated from S- or L-litters. The carcass yield was higher (81 vs. 82%; $P < 0.01$), the liver (1.58 vs. 1.74 kg), and kidney (0.31 vs. 0.34 kg) were lighter ($P \leq 0.01$) in L-Btw barrows in the S- and L-litters. Drip loss and shear force was neither affected by litter size nor by Btw. The LM of L-Btw was less red (6.1 vs. 6.9; $P = 0.02$) than the LM of H-Btw barrows and b*-values of the ST was lower (3.4 vs. 3.8; $P = 0.03$) in barrows originating from L- than from S-litters. The present results confirm the marked effect of Btw on growth performance whereas the hypothesized impact on carcass characteristics and meat quality could not be demonstrated. Although the litter size affected average Btw its impact on growth performance, carcass and meat quality was minor.

Key Words: Birth Weight, Litter Size, Meat Quality

Extension Education - Livestock and Poultry: Extension Dairy Session

746 A Net Present Value Dashboard of the dairy cow in a commercial setting. D. T. Galligan*, J. Ferguson, R. Munson, and D. Remsburg, *University of Pennsylvania, School of Veterinary Medicine*, *Kennett Square*.

An economic model of the production life of a modern dairy cow was created in a dashboard environment. The user enters information that characterizes the production life of a cow using sliders arranged in a menu driven series of screens: Milk and Feed $, Reproduction, BST, Heifer, Finance, Other Cost, Labor, Longevity. Over 30 input variables (management factors, production parameters, economic values) are controlled by the user. Based on entered values, an economic model of annual cash flows is created and discounted to reflect the opportunity of value money. Several gauges show: the cow net present value, annuity value per year, internal rate of return estimate, time in the herd and the resulting cull rate. These gauges respond to user changes of inputs instantly demonstrating the magnitude of impact. Lactation yields are shown in a graph format and are changed by altering first lactation yields. For example a cow having 3 lactations and culled at 100 DIM in the last lactation, with a first lactation yield of 22,000 (305 milk) valued at $13/cwt, with debt/cow at $2000 financed at 7% over ten years will have a NPV of $662 and an annuity value of $160. Use of BST starting at 100 DIM in all lactations, will increase the NPV to $925 and the annuity value to $226, assuming a 10 lb daily response and a start DIM at 100 for each lactation. Other investment strategies can be explored with the model.

Key Words: Net Present Value, Economics, Dashboard

747 Accuracy of prediction of future uniform milk prices in Florida from Class III and IV futures markets. S. Feleke* and A. De Vries, *University of Florida*, *Gainesville*.

The objective of this study was to evaluate the accuracy of a method to predict the future uniform milk price in Florida from the Class III (cheese) and Class IV (butter) futures markets. Milk futures contracts are traded at the Chicago Mercantile Exchange for delivery 1 to 18 months in the future. Futures market theory holds that futures prices may be unbiased predictors of spot prices. The uniform milk price in Florida is a function of the announced Class III and IV prices, butter price, and the utilization of Class I, II, III, and IV skim milk and butterfat prices. To accurately predict future uniform milk prices, unbiased estimates of these factors are needed. Therefore, future butter prices were predicted from the future Class IV price and the ratio of the most recently announced butter price and the Class IV price. Future

utilizations of skim milk and butterfat prices were predicted from the most recently announced utilizations. Daily traded Class III and IV futures prices from 2003 to 2006 (48 mo) were obtained and were averaged per month. The monthly average milk futures prices were taken as unbiased predictors of the actual Class III and IV prices that are announced every month by USDA. The predictions of uniform milk prices for 1 to 6 months in the future from 2003 to 2006 were used to assess the accuracy of our method of prediction. Average uniform milk price in Florida in this period was $16.53 ± 2.20 / cwt. The mean and standard deviation of the prediction error for 1-month-ahead forecast were $0.11 ± 1.01 / cwt. For 2, 3, 4, 5, and 6-month-ahead forecasts, prediction errors were $0.26 ± 0.97, $0.43 ± 1.42, $0.53 ± 1.87, $0.52 ± 2.14, $0.47 ± 2.29 $/cwt. Thus, the actual uniform milk price was typically overestimated. The majority of the prediction error was due to the inefficiency of the futures market to predict the announced Class III and IV prices by USDA. The implication of the study is that the uniform milk price in Florida for more than a few months into the future cannot be accurately estimated from the Class III and Class IV futures market prices.

Key Words: Futures Market, Milk Price, Prediction

748 Economic evaluation of decision choices facing dairy producers in Sicily, additional milk or additional cows? D. T. Galligan*[1], G. Azzaro[2], and G. Licitra[2,3], [1]*University of Pennsylvania, School of Veterinary Medicine*, *Kennett Sqaure*, [2]*CoRFiLaC, Regione Siciliana*, *Ragusa, Italy*, [3]*2DACP University of Catania*, *Catania, Italy*.

Thirty one dairy herds in Sicily, subscribing to the Corfilac dairy herd record collection system, were visited during 2006 and interviewed regarding basic herd characteristics (cow demographics, production levels, culling rates, calving interval) and economic factors (milk price, cow purchase price, calf value, variable production cost, quota cost, financing options) associated with their herd. Under the quota system, additional milk either from existing cows or by adding cows must have quota purchased and financed (mean rate 5.1%/year and terms 5 years). Of the herd reporting their purchased quota, eight herds were producing below their purchased quota, while 10 herds were at quota and 11 over. Milk price per kg averaged .37 Eur/kg (range .30 -.40) and the average herd size was 84 (range 20 to 340) with cows producing an average of 6721 kg/yr (range 1,100 to 25,500). The herds would increase marginal profits per/cow/year by increasing milk yield by 1 kg/day (average 107 Eur) and with the purchase of quota (average 77 Eur/cow/year). Twenty two herds were estimated to see a positive profit by adding an additional cow averaging 966 Eur/cow/yr without quota purchase. Fifteen herds were estimated to see a positive profit by adding an additional cow and purchasing the necessary quota averaging 357 Eur/cow/year. If the additional cow can be added to the herd without additional labor, then the marginal increases per cow are 1454 Eur/cow/year without quota purchase and 846 Eur/cow/year with quota purchase. Economic analysis of existing farm situation can help producers make more informed decisions concerning cow numbers and quota purchase.

Key Words: Economics, Quota, Marginal

749 Spartan Dairy Ration Evaluator/Balancer Version 3: A user-friendly, windows-based software program for dairy nutrition management. M. J. VandeHaar*, H. F. Bucholtz, D. K. Beede, M. S. Allen, and R. D. Kriegel, *Michigan State University*, *East Lansing*.

Version 2 of the Spartan Dairy Ration Evaluator/Balancer software program was used widely because it was user-friendly and enabled formulation of reasonable diets relatively quickly. Our goal with version 3 was to retain those aspects of version 2 that made it successful, while also incorporating the latest scientific findings related to diet formulation and completely redesigning the program as a MS Windows application. The nutrition model largely is based on the 2001 version of the Nutrient Requirements of Dairy Cattle by the National Research Council (NRC). The 2001 NRC made fundamental changes in the sub-models for almost all nutrients. The NRC model was designed as an evaluation tool and created some challenges for routine use in formulating diets on farms. Version 3 of Spartan Dairy incorporates modifications of the 2001 NRC system, but energy and protein values based on the 1989 and 2001 NRC systems can be monitored simultaneously. Some of the most notable changes in Spartan version 3 compared with version 2 are that the predicted feed intake is greater, energy values of diets are calculated based on nutrient composition and depend upon rate of feed intake, the % CP required is typically lower, mineral adequacy can be assessed on an absorbed basis, concentrations of met and lys can be tracked, and N and P excretion are predicted. Many of these changes are based on the 2001 NRC. Spartan Dairy 3 is a stand-alone Windows application written in Delphi that stores data in MS Access database files. Like Spartan Dairy 2, the application features a ration worksheet at its center. It also includes the ability to open multiple rations and feed libraries simultaneously, and graphics to display nutrient adequacy. It features movable columns, feed characteristics organized by tabs, the ability to copy and paste feeds to and from MS Excel, previews of printed reports, and, of course, you can now use your mouse! The program works best with computers running Windows XP or later. Spartan Dairy 3 should prove to be a useful tool for use in formulating diets for commercial farms as well as for teaching.

Key Words: Dairy Cattle, Nutrition, Software

750 Nitrogen and phosphorus in by-product feeds and dairy diets in central Texas. T. D. Nennich*[1], N. M. Cherry[1], R. A. Whitney[2], R. J. Scott[3], and W. H. Weems[4], [1]*Texas A&M University*, *Stephenville*, [2]*Texas Cooperative Extension*, *Comanche*, [3]*Texas Cooperative Extension*, *Stephenville*, [4]*Texas Cooperative Extension*, *Hamilton*.

Environmental concerns associated with N and P in surface and ground waters have encouraged efforts to improve management of these nutrients on dairy operations. Understanding the nutrient variation in feeds provides an opportunity to fine tune the nutrient content of the diet and decrease the overfeeding of nutrients. A study was conducted to determine the amount of N and P in dairy diets and by-product feedstuffs in Central Texas. Samples were collected from 50 dairy operations, representing over 40,000 cows, in central Texas. Producers were asked to complete a survey on their knowledge and the importance of P in their dairy rations. Samples of total mixed rations (TMR) were collected from each dairy operation, along with individual by-product feeds whenever they were available. Samples were collected by taking approximately 10 grab samples, compositing and mixing the sample,

and taking a sub-sample. By-product feed samples were collected from commodity barns, and TMR samples were collected at several places along the feed lane. A total of 12 by-product feeds were collected, including dried distillers grains, wet brewers grains, canola pellets, corn gluten pellets, and wheat midds. Diet and feed samples were analyzed to determine crude protein (CP) and P concentration. Overall, 54 TMR samples and 52 individual by-product feed samples from 50 dairy operations were collected. The CP and P contents of the TMR samples collected averaged 18.7% and 0.44% on a dry matter basis, respectively. The phosphorus contents of by-product feeds were greatly variable and often differed from average book values. For example, corn gluten feed samples (n = 8) averaged 22.3% CP and 0.67% P as compared to 2001 Dairy NRC book values of 23.8% CP and 1.00% P. Reducing the concentrations of N and P in dairy diets to recommended levels reduces nutrient excretion and improves the overall balance of these nutrients on dairy operations.

Key Words: Dairy, Nitrogen, Phosphorus

751 An evaluation of family farm transfer in Vermont. S. Purchase[1], C. Ballard*[2], and D. Maynard[1], [1]*University of Vermont*, *Burlington*, [2]*W.H. Miner Agricultural Research Institute*, *Chazy, NY*.

One of the most significant challenges to a family farm operation is the transfer of ownership to the next generation. Two surveys were developed to identify obstacles to farm transfers as determined by professionals who work with farmers during the transfer process and by farmers themselves. A total of 6 farm transfer professionals and 42 farmers throughout the state of Vermont completed a 4-page survey. The respondents from non-dairy farms, small dairy (<100 milking cows), medium (100-300 cows), and large farms (>300 cows) were 7.1, 40.5, 31, and 21.4 %, respectively. Thirty-four percent of the farms had been in operation for over 50 years and 53.7% were sole proprietorships. Ninety-eight percent of the farms had 2 or more family members involved with the day-to-day operation of the farm. Nearly half of the respondents indicated their plans for bringing additional family members into the business as owners. Half of the farms surveyed had been family-owned for at least one generation. These farmers were asked to rank obstacles experienced during the process of transferring farm ownership (1=most, 5=least significant). Both interpersonal relations with farm family members and the business plan were ranked 1 or 2 for 62% of respondents. The farmers who experienced difficulties with family members during the transfer process identified personal temperaments as contributing more to these conflicts than money, time commitment or work responsibilities. Although the business plan was considered an obstacle during past farm transfers, less than 10% of the farms surveyed had a 5-10 year business plan for their farm. In looking ahead to the future farm transfer, 72% felt the business plan would be the primary obstacle, ranking 1 or 2. Interpersonal relations with farm family members was predicted to be a substantial obstacle for 53% with personal temperaments and time commitment being the primary contributor to the conflict. Five of six professionals surveyed find a 5-10 year written plan is beneficial during a farm transfer. However, all professionals identified interpersonal relations with farm family members as being the most significant obstacle as farm ownership is conveyed to the next generation.

Key Words: Family Farm, Transfer

752 A survey of AABP-L members concerning training of farm personnel. D. W. Remsburg*, D. T. Galligan, and J. D. Ferguson, *University of Pennsylvania School of Veterinary Medicine*, *Kennett Square*.

A survey regarding the frequency of veterinary tasks, issues facing the dairy industry, skills desired in a herd manager, and disadvantages of working with a herd manager was conducted as part of a pilot herd manager project. An internet link to 21 questions was distributed to the American Association of Bovine Practitioners Listserv in December 2006. Eighty-seven veterinarians from 30 states and 6 countries participated. On average, respondents worked in practices containing 3.93 vets and 1.61 veterinary technicians. The mean practiced allocated its services as follows: 67.2% Dairy, 18.6% Small Animal, 9.6% Beef, and 4.6% other. The most frequent tasks performed by veterinarians were pregnancy exams, surgery, and postpartum reproductive exams. The least frequent services performed were milking system evaluation, ration formulation, and labor management consulting. Veterinarians principally serving herds of greater than 1200 cows performed postpartum checks and surgery less often than did their colleagues. When asked about issues facing the dairy industry, implementing, learning and client adoption of new technologies were respondents' largest concerns. However, when characterized by region and principle herd size served the concern regarding decreasing number of farms, biosecurity, time available for family and recreational activities, income from veterinary service, foreign animal disease outbreak and animal welfare differed. In regards to desired herd manager skills, veterinarians thought management of fresh cows, record keeping and diagnosis and treatment of sick cows were the most important tasks a herd manager should be trained to accomplish. Milking instruction and labor management were rated of higher importance by veterinarians working with medium (301-600 cows) and large (>1200 cows) farms, while fresh cow management was less important to large farm vets. These results demonstrate the difference in frequency of veterinary tasks, concerns about the dairy industry and skills expected of herd managers, and the need to account for these demographic and regional variations when offering training to on-farm personnel.

Key Words: Veterinary Service, Staff Rraining, Management

753 The "Summer to Winter performance ratio" as a tool for evaluating heat stress relief efficiency of dairy herds. I. Flamenbaum*[1] and E. Ezra[2], [1]*Ministry of Agriculture, Extension Service*, *Beit-Dagan, Israel*, [2]*Israel Cattle Breeders Association*, *Caesarea, Israel*.

Summer conditions in Israel make heat stress relief from cows an important tool for efficient milk production. New cooling methods have been developed and introduced to dairy farms all over the country. The Extension Service of the Israeli Ministry of Agriculture in cooperation with the Israel Cattle Breeders Association (ICBA) have developed a computerized report, based on the "Israeli Herd book" data, that evaluates the effectiveness of farmer's activities in reducing the impact of summer on cow's performance. The "Summer to Winter (S:W) performance ratio" report includes S:W Economical Corrected Milk (ECM), fat, protein, Somatic Cells Count (SCC) and Conception Rate in the first five inseminations (C.R.). The higher the ratio is (close or above 1.0) for production and fertility data and the lower ratio is for SCC data, the better the farm is dealing with summer heat-stress. The calculation includes the estimation of L.S.M for milk yield (ECM-kg/day) fat and protein percent, SCC (000/ml) and conception rate

percent for each season, followed by calculation of S:W ratios. During 2005, S:W ECM ratios above 0.96, 0.90 to 0.96 and below 0.90 were recorded in 40, 38 and 22% of the dairy farms in Israel respectively. S:W - ECM, fat, protein, SCC and C.R. ratios were 0.93, 0.94, 0.96. 1.2 and 0.4, in 495 family farms averaging 50 cows and 0.93, 0.95, 0.96, 1.05 and 0.51, in 191 cooperative farms averaging 300 cows, respectively. High, middle and low producing herds (mean winter ECM yields of 35.2, 33.1 and 30.2 kg/d respectively), had S:W ratios of 1.03, 0.93, 0.82 and 0.63, 0.51, 0.38 for ECM and C.R. respectively. S:W production ratio was above 0.96 in 70% of the farms located in cool regions, compared to only 30% of the farms located in extremely hot regions. The computerized report described here, enables the detection of farms that need improvement of summer performance and allows the provision of necessary consultancy and follow up by extension agents.

Key Words: Heat Stress, Milk Production, Conception Rate

Lactation Biology: Applied Lactation Biology

754 Induced lactation in nulliparous dairy goats with or without prolactin secretion enhancement. A. A. K. Salama*, G. Caja, E. Albanell, S. Carné, R. Casals, and X. Such, *Universitat Autònoma de Barcelona*, *Bellaterra, Spain*.

Fourteen Murciano-Granadina nulliparous goats were used to evaluate the effects of a standard protocol for inducing lactation with or without using a prolactin releasing agent (reserpine). Goats were submitted to a hormonal challenge consisting of daily s.c. injections of estradiol-17β and progesterone (0.5 and 1.25 mg/kg BW, respectively) for 7 d (d 1 to 7). Goats were divided into 2 groups and i.m. injected with 1 mg/d of reserpine (n = 7) or vehicle as control (n = 7) on d 12, 14, 16, 18 and 20. Lactation was triggered by i.m. injections of dexamethasone (10 mg/d) during d 18 to 20. Goats were machine-milked once daily from d 21 to 120 when goats were mated jointly with the rest of the herd after the buck effect. Goats initiated lactation on d 21 (100%) and milk yield increased logarithmically ($R^2 = 0.95$) thereafter. Difference in milk yield between control and reserpine goats increased as lactation advanced, peaking at wk 10 of lactation when reserpine goats yielded more milk than control goats (1,079 vs. 850 mL/d, respectively; $P = 0.08$). However, milk yield at the peak averaged only 55% of peak milk yield observed in primiparous goats from the same herd. Composition of initial milk (d 21) was lower than the expected for colostrums ($P < 0.001$). Milk composition steadied after d 3 of lactation. Teat length increased in control goats during mammogenesis (d –2 to 35; $P < 0.05$) but steadied in reserpine goats. Distance between teats, and volume and depth of the udder increased ($P < 0.05$) similarly in both goat groups during mammogenesis and lactation. After mating, 82% of the contemporaneous goats in the herd became pregnant, whereas only 21% of the experimental goats conceived (1 reserpine and 2 control goats), revealing the occurrence of side effects after the lactation induction treatment. In conclusion, lactation induction was effective and reserpine improved milk yield in nulliparous goats, but it seems that neither the obtained milk yield nor the side effects on fertility support its recommendation in practice.

Key Words: Lactation Induction, Prolactin, Dairy Goat

755 Effects of shortening the dry period from 60 to 40 days on milk yield and composition during the subsequent lactation. D. J. Grusenmeyer*, C. M. Ryan, R. W. Everett, D. M. Galton, and T. R. Overton, *Cornell University*, *Ithaca, NY*.

Holstein cows (n = 306) at the end of first (n = 158) or greater (n = 148) lactation on three commercial farms were used to determine effects of dry period length on subsequent milk yield and composition. Cows producing 22 kg/d of milk or more at 60 d before expected calving were assigned randomly to receive either a 60 d (actual mean = 58.5 d; n = 150) or 40 d (actual mean = 40.6 d; n = 156) dry period. Milk yield and composition data were collected for the first 10 monthly test days of the subsequent lactation; previous 305-d mature equivalent milk yield for each cow was used as a covariate during data analysis. Shortening the dry period from 60 to 40 d decreased milk yield (39.2 vs. 37.7 kg/d; $P < 0.004$); however, the difference was attributable largely to effects on one farm (40.4 vs. 40.3; 40.8 vs. 37.4; 36.3 vs. 35.4 kg/d; farm by treatment, $P < 0.02$) for 60 vs. 40 d dry on the three farms, respectively, and to cows at the end of their first lactation (39.6 vs. 37.1 and 38.8 vs. 38.4; treatment by parity, $P < 0.04$). Shortening the dry period tended to increase subsequent milk fat content (3.63 vs. 3.70; $P < 0.11$) and increased true protein content (2.98 vs. 3.05; $P < 0.001$); therefore, overall effects of dry period length on yields of milk fat (1.41 vs. 1.38 kg/d; $P = 0.18$) and true protein (1.15 vs. 1.13 kg/d; $P = 0.29$) were not significant. Farm by treatment interactions ($P < 0.04$) for yields of milk fat and true protein followed the same pattern as those described for milk yield. Somatic cell linear score was not affected by dry period length (2.76 vs. 2.79; $P < 0.81$), athough effects varied by farm (farm by treatment, $P < 0.04$). Results from data analysis following Test Day Model adjustment were consistent with those reported above. Overall, results support the concept that shortening the dry period of multiparous cows from 60 to 40 d results in minimal impact on subsequent production, and that shortening the dry period of primiparous cows from 60 to 40 d may decrease subsequent production.

Key Words: Dry Period, Transition Cow

756 Effects of altered timing and duration of unilateral frequent milking during early lactation on milk production of dairy cows. E. H. Wall* and T. B. McFadden, *Lactation and Mammary Gland Biology Group, Department of Animal Science, University of Vermont*, *Burlington*.

Several studies have reported that increased milking frequency during early lactation can elicit immediate and long-lasting increases in milk yield, however the timing and duration of frequent milking has not been optimized. Our objective was to utilize a half-udder model to determine milk yield response to 2 wk of frequent milking imposed at two different times in early lactation. Multiparous Holstein cows were assigned at parturition to unilateral frequent milking (UFM), which entailed twice-daily milking (2X) of the left udder half and four-times daily milking (4X) of the right udder half on d 1 to 14 (UFM-1-14) or 7 to 21 (UFM-7-21) of lactation (n = 10 cows per treatment). Before

and after UFM, cows were milked 2X. Half-udder milk weights were measured at 1, 3, 7, 14, 21, 28 and 35 DIM, then once every 3 mo for the remainder of lactation. For both treatments, the 4X udder halves produced more milk than the 2X udder halves during UFM (P's < 0.001), resulting in an average difference of 3.7 ± 0.7 kg/d in UFM-1-14 cows and 2.9 ± 0.9 kg/d in UFM-7-21 cows. After cessation of UFM, milk production of the 4X udder halves decreased in both treatments (P < 0.01). However, throughout the remainder of lactation, UFM-7-21 cows produced 1.5 ± 0.6 kg/d more milk from the 4X side than the 2X side (P < 0.05), whereas in UFM-1-14 cows the difference was 1.2 ± 0.7 kg/d, which was not significant (P=0.16). The mean difference in milk yield between 4X and 2X udder halves over the entire lactation was not different between UFM-1-14 and UFM-7-21 cows (P > 0.50). Moreover, the total milk yield response to UFM observed in the current study did not differ from that observed in a previous study in which cows were assigned to UFM for days 1 to 21 of lactation (P > 0.60). We conclude that UFM during days 7 to 21 of lactation elicited a persistent increase in milk production of the frequently-milked udder half. In addition, the overall milk yield responses observed for UFM-1-14 or UFM-7-21 were not significantly different than that previously observed for UFM on days 1 to 21 of lactation.

Key Words: Frequent Milking, Local Regulation, Mammary Gland

757 Use of milking frequency for alleviating milk depression in Holstein dairy cows under heat stress conditions. R. Ben Younes[1], M. Ayadi[2], T. Najar[1], M. Zouari[3], A. A. K. Salama[4], X. Such[4], M. Ben M'Rad[1], and G. Caja*[4], [1]*Institut National Agronomique de Tunisie*, *Tunis, Tunisia*, [2]*Institut Superieur de Biologie Appliquée de Medenine*, *Tunisia*, [3]*Office des Terres Domaniales*, *Tunis, Tunisa*, [4]*Universitat Autònoma de Barcelona*, *Bellaterra, Spain*.

Forty-eight Holstein Friesian cows raised in North Tunisia were used to study the effects of increasing milking frequency during summer heat stress. Twice daily milked cows (170 DIM, 18.0 L/d, 3.43% fat, 3.09% protein) were grouped in early July according to udder cistern size (large-cisterned, 44.5 cm^2; small-cisterned, 20.6 cm^2) and randomly allocated to a milking frequency treatment (×2 or ×3) for 70 d. Average temperature, relative humidity and thermohygrometric index (THI) during the experiment ranged between 20.9-30.2°C, 49-78% and 67-81. Lactational performance and physiological traits were recorded fortnightly and monthly, respectively. Initial milk yield was used as covariate. Respiratory rate and rectal temperature showed the highest correlations (r > 0.9) with temperature on test-days. Heat stress symptoms on rectal temperature, and respiratory and heart rates were detected when THI was greater than 64, 75 and 78, respectively. Increases per THI unit were 0.2°C, 5 breaths/min and 1 beat/min, respectively. Milk yield was decreased by effects of heat stress and lactation stage during the experiment (P < 0.001) but milk losses reported in ×3 cows were half those of ×2 cows (–2.3 vs –4.7 L/d; P = 0.08). Decrease in milk yield was accompanied by a marked increase in milk fat (16%; P < 0.01) but no effect on milk protein was found (P = 0.39). As a result, only 5% loss in energy corrected milk was observed in ×3 cows at the end of the experiment. Milk urea decreased 22% on average during the experiment (P < 0.001). No interaction between cistern size and milking frequency was detected for milk yield (P = 0.70) or milk losses (P = 0.25). In conclusion, temperatures above 25ºC induced heat stress symptoms in Holstein cows raised in Tunisia, which was observed when THI was greater than 64. Best external indicator for detecting heat stress was respiratory rate which markedly increased when THI > 75. Milk yield depression due to heat stress was partially alleviated by ×3 milking which may be a useful short-term strategy for Tunisian dairies.

Key Words: Heat Stress, Milking Frequency, Dairy Cows

758 Comparison of manual and automatic milk flow recording in dairy goats. G. Caja[1], M. Rovai*[2], S. Carné[1], A. A. K. Salama[1], X. Such[1], and R. M. Bruckmaier[3], [1]*Universitat Autònoma de Barcelona*, *Bellaterra, Spain*, [2]*E (Kika) de la Garza American Institute for Goat Research*, *Langston, OK*, [3]*Veterinary Physiology, University of Bern*, *Switzerland*.

A total of 24 multiparous Murciano-Granadina dairy goats milked once-daily were used at wk 12 of lactation to compare manual and automatic methods for milk flow recording during routine milking. Goats were machine milked in a 2 x 12 parallel milking parlor with low milk pipeline at 42 kPa vacuum, 90 pulses/min and 66% pulsation rate. At least 3 replicates for each method and each goat were randomly done during consecutive days (169 milk flow curves in a total of 10 d). Manual flow (MF) recording was done by udder half using millimetric paper strips in conical milk jars of 2 L (Westfalia-Surge Ibérica, Granollers, Spain) with manual marks done every 5 s. Automatic flow (AF) recording was done in whole udder using a Lactocorder (WMB, Balgach, Switzerland) specially calibrated for cow quarter milking. Both milk recording devices were placed at the same height under the milking platform. Milk flow curves were classified into 4 groups according to curve shape and maximum peak flow (sharp and >1.5 L/min; plateau and >1.0 L/min; interrupted plateau; flat and <1.0 L/min). Five MF and 5 AF curves were discarded. Percentages of curves by group were 24:35:12:29 (n = 61) and 44:23:8:25 (n = 98) for MF and AF respectively. Repeatability within (R > 0.9) and correlation between methods (R^2 = 0.80) were high. Sixty percent of goats (MF, 62.5%; AF, 58.3%) were included in the 2 first curve groups considered more favorable for milkability. Total milk yield was similar for both methods (MF, 2.08 ± 0.06 L; AF, 2.01 ± 0.05 L; P = 0.48), but milking time before machine stripping (2.00 vs. 2.56 min; P =0.05) and maximum milk flow in the 1st min (1.78 vs. 1.16 L/min; P = 0.11) were 28 and 54% higher for MF vs. AF. On the contrary, recorded values for milk amount collected in 2 min (1.61 vs. 1.78 L; P = 0.23) and in 3 min (1.77 vs. 2.47 L; P <0.001) were overestimated by AF in regard to MF. In conclusion, milk yield, shape and class of milk flow curves were adequately recorded by both methods. Nevertheless, large differences were found on most milk flow traits, the automatic method requiring more accurate calibration for low flow conditions.

Key Words: Milking Ability, Dairy Goats, Milk Flow

759 Comparisons of teat structure changes after milking between farms with high and low bulk somatic cell counts. P. Vinitchaikul* and W. Suriyasathaporn, *Faculty of Veterinary Medicine, Chiang Mai University*, *Muang, Chiang Mai, Thailand*.

Objectives of this study were to evaluate the changes in teat structures after milking between farms with high and low bulk somatic cell counts. Thirty-nine lactating cows from 10 small-holder dairy farms in Chiang Mai and Lamphun provinces, Thailand, were selected. Milk samples were collected from all quarters to measure somatic

cell counts (QSCC). The teat structures were examined using the ultrasound machine model ALOKA SSD 500 with 5 MHz linear probe. The teat structures consist of teat-canal length (TCL), teat-width (TW) at the top of the teat canal, teat-wall thickness (TWT) at 1 cm above the end of the teat canal and teat-cistern width (TCW) at the same level. On each teat, all structures were scanned before and after the evening milking period. Data on the averages of bulk milk somatic cell counts (BSCC) for the month of experiment were collected from their farm's cooperatives. Farms with BSCC more than 300,000 cells/ml were defined as high BSCC (HBSCC). Student's T Tests were used to compare the changing of teat structures after milking and log of QSCC between quarters from farms with high and low BSCC. Results show that average BSCC of farms with high and low BSCC was 372 ± 25.5 (n=5) and 197 ± 41.6 (n=5) x1,000 cells/ml, respectively. The QSCC and percent changes in TWT and TCW were different between farms with high and low BSCC ($P < 0.05$). Percentage of changes in TWT and TCW of HBSCC farms (9.75% and -18.42%, respectively) were significantly different from farms with low BSCC (2.42% and -8.38%, respectively). In conclusion, the changes in teat structures after milking are associated with BSCC.

Key Words: Teat, Somatic Cell, Milking

Production, Management & the Environment - Livestock and Poultry: Livestock Production and Management

760 Effects of winter feeding systems on cow performance, soil nutrients, and crop biomass. B. M. Kelln*[1], H. A. Lardner[1,2], J. Schoenau[1], and K. Lang[1], [1]*University of Saskatchewan*, *Saskatoon, Saskatchewan, Canada*, [2]*Western Beef Development Centre*, *Lanigan, Saskatchewan, Canada*.

Two experiments were conducted to determine the effects of winter feeding systems on beef cow performance, soil nitrogen (N), and crop yield (DMY) the following year. The research site was a 40 hectare field seeded to barley (*Hordeum vulgare*) (cv. Ranger), located on Orthic Black soil. At the site, experiment one consisted of 36 hectares that was used for a winter feeding trial, while experiment two consisted of a 4 hectare paddock that was used for compost vs. fresh manure trial. In experiment one, crossbred pregnant beef cows (n=180) (range 626 to 634 kg) were allocated to one of four replicate (n=3) winter feeding systems. Feeding systems included (1) field bale grazing (BG), round barley greenfeed bales fed *ad libitum*; (2) field straw & chaff grazing (ST/CH), barley straw/chaff piles fed *ad libitum*; (3) field swath grazing (SG), barley swaths fed in windrows *ad libitum*; and (4) drylot feeding (DL), round barley greenfeed bales fed *ad libitum* in bunk. Cows were weighed at start, every 21 d and end of feed period. Ultrasound measurements (rib and rump fat) and body condition scores [5-point scale (1=thin, 5=fat)] were taken at the start and end of feed period. In experiment two, fresh (FM) and composted (CM) manure from the DL system was applied mechanically in the fall on replicated plot areas (n=4). Spring soil samples were taken from high, mid, and low slope positions (n=3), at the 15 cm soil levels for both experiments. DMY was estimated for both experiments by sampling (n=5) using meter quadrats. In experiment one, manure distribution of each treatment was mapped using a 32 point grid and computer analysis programming. Cow body weight ($P<0.01$), was minimally affected by the swath graze treatment. Soil N levels were not significantly different ($P>0.10$) between slope positions or treatments. Results indicate that extensive winter feeding systems on annual cropped fields have minimal effects on cow performance, DMY and soil N levels.

Key Words: Dry Matter Yield, Straw/Chaff Grazing, Swath Grazing

761 Incorporating condensed corn distillers solubles into an integrated pasture and drylot finishing system for feedlot steers. T. Purevjav*, M. P. Hoffman, and W. B. Roush, *Iowa State University*, *Ames*.

The objectives of this experiment were to evaluate the use of condensed corn distillers solubles (CCDS) mixed with chopped corn stalks on a pasture and drylot growing-finishing program. A three-year study was conducted, using 112 Angus and Angus crossbred steer calves each year. Calves were weighed and assigned to four treatment groups by weight and color pattern, with 4 replications, and 7 cattle per replication in each year respectively. Treatments one (TRT 1) and two (TRT 2) were fed in the feedlot from May until harvested. TRT 1 included chopped alfalfa hay and corn, and TRT 2 included chopped corn stalks and CCDS. Treatments three (TRT 3) and four (TRT 4) utilized rotational bromegrass pasture grazing (May-September) with TRT 4 also receiving chopped corn stalks and CCDS. Following pasture, chopped alfalfa hay and corn (TRT 3) or chopped corn stalks and CCDS (TRT 4) were provided during the feedlot finishing period. Steers were weighed every 28 days and daily feed intake was recorded to obtain feed consumption and feed conversion among the treatments during drylot feeding. The bromegrass pasture consisted of 24 paddocks, each .69 ha in size. Cattle were fed on average to 591 kg and harvested to obtain carcass measurements. Comparing TRT 1 vs. TRT 2 and TRT 3 vs. TRT 4, TRT 1 and TRT 3 had greater daily DMI and ADG ($P<0.05$) than TRT 2 and TRT 4, respectively. Feed conversion during the drylot feeding period favored TRT 1 over TRT 2 and TRT 3 over TRT 4 ($P<0.05$), and overall TRT 1 and 2 over TRT 3 and 4 ($P<0.05$). When TRT 3 and TRT 4 were removed from pasture, TRT 4 had gained well over .23 kg/day better than TRT 3. Though this advantage did not carry over into drylot feeding, this might be a function of daily energy intake while on pasture. Average carcass weights and liver abscesses were not significantly different across treatments, but differences were found among treatments ($P<0.05$) for loineye area, backfat thickness and kidney, pelvic and heart fat. The finding resulted in a sligthly higher quality grade for cattle fed in the feedlot and on hay for the duration of the feeding period. Overall treatment responses for yield and quality grades were similar.

Key Words: Feedlot Cattle, Pasture, Condensed Corn Distiller Solubles

762 Effects of pre-breeding target weight and progestin on reproduction, calving parameters, and rebreeding in beef heifers. J. L. Martin*, K. W. Creighton, J. A. Musgrave, D. C. Adams, and R. N. Funston, *University of Nebraska West Central Research and Extension Center*, *North Platte*.

Two experiments evaluated pre-breeding target weight or progestin exposure for heifers developed lighter than traditional recommendations. Exp. 1 evaluated effects of system on heifer performance through subsequent calving and re-breeding over 3 yr. Heifers (229 kg) were assigned randomly to be developed to 55% mature BW (MBW; 299kg) before a 45-d breeding season (Intensive, INT; n = 119) or 50% MBW (272 kg) before a 60-d breeding season (Relaxed, RLX; n = 142). Pre-breeding and pregnancy diagnosis BW were greater (P < 0.001) for INT than RLX. Overall pregnancy rate did not differ (88.5%; P = 0.51), but RLX heifers had lower conception rate the first 30 d of the breeding season (67.9% vs. 81.8%; P = 0.03), later calving dates (9 d; P < 0.001), and lighter calf weaning BW (190 vs. 197 kg; P < 0.001) compared to INT. Calf birth BW (P = 0.61), calving difficulty (P = 0.30), weaning rate (P = 0.67), second-calf conception rates (P = 0.70), and 2-yr old retention rate (73.4%; P = 0.82) did not differ between systems. Of heifers that failed to become pregnant, more (P = 0.07) RLX than INT heifers were pre-pubertal when the breeding season began. Therefore, a second 2 yr experiment evaluated melengesterol acetate (MGA, 0.5 mg/d) as a means of hastening puberty in heifers developed to 50% MBW. Heifers were assigned randomly to receive CON (n = 103) or MGA (n = 81) for 14 d and placed with bulls 13 d later for 45 d. Pre-breeding and pregnancy diagnosis BW were similar (280 kg and 380 kg, respectively; P > 0.10) for CON and MGA. Proportion of heifers pubertal prior to breeding (74%), pregnancy rate (90%), calving date, calf weaning BW, and second breeding season pregnancy rate (92%), were similar (P > 0.10) between treatments. Developing heifers to 50 or 55% MBW resulted in similar overall pregnancy rates and supplementing heifers developed to 50% MBW with MGA prior to breeding did not improve reproductive performance.

Key Words: Heifer Development, Progestin, Target Weight

763 Simulation model of fat deposition and distribution in beef steers: 3. Model description and development. M. J. McPhee*[1,2], J. W. Oltjen[1], J. G. Fadel[1], and R. D. Sainz[1], [1]*University of California*, *Davis*, [2]*NSW DPI*, *Armidale, Australia*.

The 1st objective of this study was to describe the first-order differential equations of intermuscular (INTER), intramuscular (INTRA), subcutaneous (SUB), and visceral (VIS) fat (kg) depots in the Davis Growth Model of fat deposition and distribution. The 2nd objective, using acslXtreme (Hunstville, Alabama USA, Xcellon), was to (a) estimate the parameters for protein synthesis ($kg^{0.27}$) and maintenance ($Mcal.kg^{-0.75}.day^{-1}$) and (b) estimate parameters for the 4 fat depots (1/kg DNA). The data used are from a meta-analysis study of implanted and nonimplanted steers across a range of frame sizes. The 3rd objective was to test the hypothesis that different fat depots are metabolically different. Parameter estimates for protein synthesis ($kg^{0.27}$) were 0.0487 ± 0.0001 and 0.0467 ± 0.0001 for implanted (n = 94) and nonimplanted (n = 44) steers, respectively and parameter estimates for maintenance ($Mcal.kg^{-0.75}.day^{-1}$) were 0.1133 ± 0.0014 and 0.1035 ± 0.0026, for implanted (n = 94) and nonimplanted (n = 42) steers, respectively. A 4.1% increase in the protein synthesis parameter was detected between implanted and nonimplanted steers. Fat depot parameters (1/kg DNA) were estimated and no differences between implant status and frame size were detected. The mean (n = 129) of the 4 fat depot parameter coefficients were 0.1596 ± 0.0061, 0.3447 ± 0.0049, 0.2715 ± 0.0061, and 0.2242 ± 0.0063 for INTER, INTRA, SUB, and VIS, respectively. This study suggests that fat depots are not metabolically different between frame sizes and implant status at the level of aggregation used to simulate fat deposition in beef steers. Therefore the mean of the 4 fat depot parameter coefficients would be used in the first-order differential equations in the Davis Growth Model.

Key Words: Fat Depots, First-order Differential, Parameter Estimation

764 Simulation model of fat deposition and distribution in beef steers: 4. Model evaluation. M. J. McPhee*[1,2], J. W. Oltjen[1], J. G. Fadel[1], and R. D. Sainz[1], [1]*University of California*, *Davis*, [2]*NSW DPI*, *Armidale, Australia*.

The first-order differential equations for intermuscular (INTER), intramuscular (INTRA), subcutaneous (SUB), and visceral (VIS) fat depots (kg) in the Davis Growth Model of fat deposition and distribution in beef steers were evaluated. The models were challenged with an independent data set (ad libitum and limit fed finishing steers, frame size=5.6, no implants; n=107; BW=288 to 557 kg; ADG=0.55 to 2.45 kg/d; body fat=20 to 153 kg; backfat=0.51 to 17.78 mm; IMF=0.47 to 8.09 %; KPH=0.5 to 3.5 %) that looked at compensatory growth in steers that had been subjected to different forms of restriction in the growing phase. Carcass characteristics were converted to their respective kg of fat. Several techniques were used to evaluate the model: (a) mean bias (MB, observed – model-predicted); (b) modeling efficiency (MEF, values close to 1 indicate a perfect model and values < 0 indicate a very poor model); (c) Kolmogorov-Smirnov (KS) 2-sample test; and (d) linear regression. The KS was a test of the hypothesis that the observed and model-predictions have the same parent distribution. The linear regression evaluated slope=1, intercept=0 and bias using the simultaneous F-statistic for both slope=1 and intercept=0. The results were: MB of 1.95, -0.33, -0.07, and -1.15 kg; MEF of 0.75, 0.63, 0.64, and 0.56, for INTER, INTRA, SUB, and VIS, respectively; the KS test (P=0.01) indicated that the observed and model-predicted values were from the same parent distribution for all fat depots and the linear regression indicated there was no bias P=0.19, P=0.33, for INTRA and SUB, respectively and some bias P=0.02, P<0.01 for INTER and VIS, respectively. The results from this study show a reasonable degree of precision (MEF) although differences do exist between treatments. On the average (MB) the model over predicts for INTRA, SUB, and VIS however the model tends to under-predict fat as fat increases in the carcass. This under-prediction as fat increases in all 4 fat depots could possibly be due to a secondary phase of hyperplasia that is not currently represented. Additional data sets to challenge the model are required to confirm this phenomenon.

Key Words: Carcass Characteristics, Fat Depots, First-order Differential

765 Use of neonatal blood parameters to predict weaning weight in Brahman cattle. J. P. Banta*[1], N. C. Burdick[1], J. C. White[1], R. C. Vann[2], D. A. Neuendorff[1], A. W. Lewis[1], J. C. Laurenz[1], T.

H. Welsh, Jr.[1], and R. D. Randel[1], [1]*Texas A&M University System*, *Overton, College Station, Kingsville*, [2]*Mississippi State University*, *Raymond*.

An experiment was conducted to determine the utility of various blood parameters obtained approximately 24 h after birth to predict future performance of beef calves. Plasma and serum samples were collected from 111 calves and analyzed for plasma protein, serum protein, IgA, IgM, and IgG concentration. Calf BW were obtained at birth and weaning (average age = 172 d); weaning BW were adjusted to 172 d of age. Based on blood concentration of each parameter, calves were assigned to low, medium, and high groups. For example, calves with plasma protein concentrations less than 1 SD below the mean were assigned to the low group (n = 23), those with concentrations greater than 1 SD above the mean were assigned to the high group (n = 21), and all remaining calves were assigned to the medium group (n = 67). This procedure was repeated for serum protein (n = 22, 69, and 20; low, medium, high, respectively), IgA (n = 8, 92, and 11), IgM (n = 0, 96, and 15), and IgG (n = 22, 73, and 16). The statistical model included the blood parameter being tested, calf sex, calf temperament, and cow temperament. Of the five blood parameters only serum protein classification had a significant effect on calf weaning BW (Table 1). Correlation coefficients were determined for each blood parameter and weaning BW; plasma protein (r=0.11; P=0.26), serum protein (r=0.11; P=0.27), IgA (r=0.14; P=0.14), IgM (r=0.19; P=0.04), and IgG (r=0.13; P=0.17). The results of this experiment suggest that of the blood parameters evaluated, serum protein concentration may be the most appropriate measure for predicting future performance of suckling calves.

Table 1. Effect of blood parameter classification on adjusted 172 d weaning BW, kg

	Low	Medium	High	SE	P =
Plasma protein	163	173	173	5.5	0.13
Serum protein	162^{x}	171^{y}	180^{z}	5.6	0.03
IgA	174	169	178	7.8	0.32
IgM	-	170	174	6.2	0.46
IgG	167	170	176	5.7	0.48

^{x,y,z}Within a row, means lacking a common superscript differ (P < 0.10).

Key Words: Serum Protein, Performance

766 Effects of pre-shipping management on measures of performance and inflammation in beef calves entering a receiving feedlot. J. D. Arthington*[1], X. Qiu[1], R. F. Cooke[1], D. B. Araujo[1], C. C. Chase[2], and S. W. Coleman[2], [1]*University of Florida-IFAS, Range Cattle Research and Education Center*, *Ona*, [2]*USDA-ARS*, *Brooksville, FL*.

Our objectives were to evaluate the effects of pre-shipping management on performance of calves subjected to a 24-h transport. The study was conducted over two consecutive years using a total of 96 crossbred steers. Steers were randomly allocated to one of four pre-shipping management strategies: 1) Control; weaned immediately prior to transport, 2) Creep-fed; free-choice access to grain for 45 d prior to weaning, 3) Pre-weaned; weaned 45 d prior to shipping, and 4) Early-weaned; weaned at 80 d of age. On d 0, calves were loaded onto a commercial truck, hauled for 24 h, and delivered into a feedlot (d 1). Calves were penned within treatment (4 pens per treatment) and provided free-choice access to hay and grain. Calf BW and blood samples were obtained on d 0, 1, 4, 8, 15, 22, 29 and 30. Concentrations of haptoglobin and ceruloplasmin were measured in blood samples. Overall calf ADG was greater for early-weaned vs. control calves. In wk 1, early-weaned calves consumed more grain and less hay compared to control calves and pre-weaned calves consumed more grain, but a similar amount of hay compared to creep-fed calves. Overall DMI intake was greatest for early-weaned compared to control, and pre-weaned compared to creep-fed calves. Feed efficiency of early-weaned calves was greater than control, but similar among pre-weaned and creep-fed calves. Haptoglobin concentrations were less in creep-fed vs. pre-weaned calves on d 0, but increased sharply after shipping and were greater than pre-weaned on d 1 and 4. In Yr. 1, control calves experienced a sharp increase in ceruloplasmin concentrations, resulting in concentrations greater than early-weaned on d 15, 22, and 29. Creep-fed calves also experienced greater ceruloplasmin concentrations than pre-weaned calves on d 29 (Yr. 1) and d 4 (Yr. 2). These data suggest that early-weaned calves (80 d of age) have improved performance in the receiving yard compared to calves weaned directly prior to transport and feedlot entry. Differences in pre-shipping management appear to significantly impact measures of the acute phase response in calves.

Key Words: Weaning, Calves, Stress

767 Water solubility of phosphorus in feedlot cattle feces and manure. V. R. Bremer*, C. D. Buckner, G. E. Erickson, and T. J. Klopfenstein, *University of Nebraska*, *Lincoln*.

Runoff from manure is a concern with elevated concentrations of phosphorus (P) in surface waters. The water solubility of P can have a dramatic impact on the runoff potential of feedlot cattle feces and manure. Two hundred fifty-four fecal samples and 158 manure samples from 15 University of Nebraska feedlot nutrient mass balance studies were analyzed to evaluate the effect of level of P intake on water extractable P (WEP). Samples were from diets ranging from 0.10 to 0.49% P. Total P (TP) of each sample was analyzed in duplicate by ashing one g of sample at 600 degrees C for six hours, refluxing with 10 mL of 3 N HCl for 5 min., standardizing to 100 mL volume with double distilled water, and filtering through Whatmann 42 filter paper. Water extractable P was analyzed in duplicate by shaking 0.5 g DM of each sample with 100 mL double distilled water at 150 rpm for one h, a 50 mL aliquot was then centrifuged at 1500 g for 10 min, 125 µL of concentrated HCl was added to a subsequent 14 mL aliquot of supernate. All samples were stored at 4 degrees C prior to colorimetric analysis with the molybdovanadate method on a spectrophotometer (400 nm) calibrated with standards developed in a matrix similar to each analytical procedure. There was a linear increase (P < 0.01) in concentration of fecal TP as dietary P level increased. Changing from a 0.30% P diet to a 0.50% P diet increased fecal P concentration 67%. Fecal WEP (% of TP) did not change as fecal TP concentration increased (P = 0.55) and averaged 40% WEP. Dietary P concentration was not related to manure WEP (P = 0.43) and averaged 23% WEP. Manure WEP increased as manure TP concentration increased (P < 0.01) but not disproportionately. Changing manure TP from 0.25% to 0.50% increased manure WEP 38%, although, there is considerable trial to trial variation. These data suggest that pen surface conditions impact the water solubility of P in feedlot cattle manure. One factor influencing P solubility is OM content of manure from open lots.

Key Words: Feedlot Cattle, Phosphorus, Solubility

768 Practices and perceptions of cow-calf producers regarding the National Animal Identification System. S. J. Breiner*[1], D. A. Blasi[1], K. M. Boone[1], T. C. Schroeder[1], and S. A. Grau[2], [1]*Kansas State University*, [2]*Beef Magazine*.

The proposed U.S. National Animal Identification System (US-NAIS) has generated many concerns among beef cattle producers. The goal of the NAIS is to utilize 48-hour traceback in the event of an animal disease outbreak. The traceback would identify all animals that have had contact with the diseased animal, while linking an animal to its premise of origin. According to the Diffusion of Innovation theory, getting a new idea adopted, even when it has clear advantages, is often very difficult. However, by adopting innovations relatively sooner than others in their system, the theory shows marked benefits for innovators and early adopters, as well as a widening of the socioeconomic gap. A national study was conducted at Kansas State University to gauge beef producer acceptance and adaptability to implement the US-NAIS. Participants were selected in the spring of 2006, from a mailing list of cow-calf producers with more than 100 head of cows. *BEEF*® Magazine provided the mailing list and a random sample of 1,000 producers was selected. The results show a knowledge gap between the proposed system and producer understanding. Producers were also divided on support for the proposed system. When ranking their level of support on a scale of 1 to 6, with 1 being strongly supportive and 6 being strongly opposed, 49% of producers showed some level of support and 48% showed some level of opposition. Data shows a mean of 3.53 with a standard deviation of 1.672. Data also highlights a lack of understanding of the regulations and implementation procedures among producers. The results of this study brought considerable insight into the current practices and perceptions of beef cattle producers, and will be used to develop educational materials to improve their understanding of this proposed program.

Key Words: Animal Identification, Beef Cattle Producers, Radio Frequency Identification

Production, Management & the Environment - Livestock and Poultry: Livestock Production, Management, and Environment

769 Effect of littered systems on pollutant emissions into the air in gestating sows. C. Pineiro*[1], G. Montalvo[2], P. Illescas[2], and M. Bigeriego[3], [1]*PigCHAMP Pro Europa, SA*, *Spain*, [2]*Tragsega*, *Spain*, [3]*Spanish Ministry of Agriculture*, *Spain*.

During the last decade, the approach to environmental issues related to animal production is changing, including concepts such as emissions to soil, water, air and proper use of energy and water. In the EU Reference Document (BREF, 2003) on Best Available Techniques (BAT) for Intensive Rearing of Poultry and Pigs several techniques were proposed for emissions abatement. In Spain, a project financed by the Spanish Ministry of Agriculture, Fisheries and Food was planned to evaluate the BAT proposed by the BREF under Spanish conditions. The aim of the present work was to assess one of the BAT proposed for gestating sows, the littered systems (straw based) using good practices (enough straw, changing the straw frequently, functional areas) on gas emissions. The study was performed in a commercial farm using 60 gestating sows housed in two different rooms during four weeks. In the first room, the reference system was implanted (total-slated floor over deep manure channel and monthly removal); whereas in the second room, concrete floor was applied and 360 kg of straw were scattered over the floor (3 kg per sow and week). The concentration of the NH_3, N_2O and CH_4 (by means of semi-continuosly monitoring using an Innova 1312 multi-gas monitor; SIR, SA, Spain) in each room were measured. The solid concrete floor system with straw reduced the average NH_3 (11%, $P<0.05$), and CH_4 (66%; $P<0.01$) in comparison with the reference system. However, N_2O emissions increased by 190% ($P<0.001$) in the littered system. From these results, we conclude that despite ammonia emissions are reduced, an important greenhouse gas (N_2O) is hugely increased. Moreover, associated costs were extremely high (extra costs was 47.6 - 55.4 euros/place and year for new installations, and 72.7 - 80.5 euros/place and year for existing installations) because of the cost of straw and the required extra labour. Hence, harmonization of this directive with others affecting animal husbandry (Council Directive 98/58 CE) should be carefully performed to avoid the impairment of environmental performance.

Key Words: Gestating Sows, Ammonia, Littered Systems

770 Effect of different dietary strategies on productive performance and gas emissions in post-weaned piglets. G. Montalvo[1], C. Pineiro*[2], J. Morales[2], S. Godbout[3], S. P. Lemay[3], M. Belzile[3], J. Feddes[4], P. Illescas[1], M. Bigeriego[5], and C. de Blas[6], [1]*Tragsega*, *Spain*, [2]*PigCHAMP Pro Europa SA*, *Spain*, [3]*IRDA*, *Canada*, [4]*U. Alberta*, *Canada*, [5]*Spanish Ministry of Agriculture*, *Spain*, [6]*UP Madrid*, *Spain*.

The objective of this study was to assess the effects of different dietary strategies on post-weaned piglets performance and gas emissions. Dietary strategies assessed were low-protein content (LP, 16.6%CP), soluble fibre through sugar beet pulp inclusion (SBP, 10%) and acidification adding benzoic acid (BA, 5%). A total of 80 piglets were fed on five different isoenergetic diets: control diet, LP, SBP, BA, and the combination of all (LP+SBP+BA) during four weeks. Ten environmentally-controlled chambers, each housing eight piglets (13.1 kg initial BW, F1 cross (Yorkshire × Landrace) × Duroc) were used to monitor: average daily gain, ADG; average daily feed intake, ADFI; gain:feed ratio, G:F, airflow rate, NH_3, CH_4, and N_2O concentrations. G:F differed among treatments, being higher in LP+SBP+BA groups (0.46 vs 0.55 kg/kg in LP+SBP+BA and control groups, respectively; $P<0.05$). This effect was due to both a lower ADG compared with SBP and BA groups (532 vs 628 as average g/d; $P<0.05$), and higher ADFI compared with that of the control group (1.16 vs 1.05 kg/d; $P<0.05$). Also showed higher ADFI than control group (1.15 as average vs 1.05 kg/d; $P<0.05$), but no differences were found in G:F or ADG among any individual dietary strategy and the control group. Ammonia emissions from the control diet where 0.9 mg/h/kg pig, and similar to the BA diet, but the LP, SBP and LP+SBP+BA diets had emission rates about 50% lower with respect to control diet ($P<0.05$). For CH_4, the control diet showed an emission of 0.851 mg/h/kg pig, whereas the LP diet decreased emission rates about 40% ($P<0.05$). Other treatments had not effect on the emission rates of this gas. Nitrous oxide emissions were similar for all treatments (around 0.017 mg/h/kg pig), except for LP+SBP+BA diets where emissions reached 0.028 mg/h/kg pig. These results show that changes in nutrition may help to control emissions to the atmosphere, without affecting animal performance.

Key Words: Piglet, Nutrition, Gas Emissions

771 Cost of ammonia emissions abatement techniques in Spain. C. Pineiro*[1], G. Montalvo[2], P. Illescas[2], and M. Bigeriego[3], [1]*PigCHAMP Pro Europa, SA*, *Spain*, [2]*Tragsega*, *Spain*, [3]*Spanish Ministry of Agriculture*, *Spain*.

The Integrated Pollution Prevention and Control Directive is mandatory in the EU from the first of January of 2007. The implementation of the best available technicques (BAT) to control emissions is a key concept to be implemented at farm scale. The objective of this study was to present a calculation on cost of every BAT under Spanish conditions. The information provided will allow defining the most cost-effective methods for reducing ammonia emission from Spanish farms. The calculation was carried out according to the methodology set out in the Reference Document on Best Available Techniques for Intensive Rearing of Poultry and Pigs, taking into account the economic life of the investment, deducting grants and including changes in performance. The costs were calculated for feeding techniques, animal housing, slurry storage and spreading techniques. Units used for assessing costs were \$/place per year for feed and housing techniques, and \$/m^3 or tonnes per year for manure or slurry storage and manure or slurry spreading categories. All these costs have been expressed also as \$/kg pig produced, because in the pig sector it is more easily understood, and it is easier to calculate the cost for all of the production process. The basis for this calculation was 20 marketed pigs of 100 kg per sow per year. Further adjustments can easily be undertaken to reflect local conditions. Extra costs calculated for abatement techniques are listed next table. The standard concepts used and the transparency of the proposed methodology allows its implementation in other countries just using the appropriate figures for local conditions.

Table 1.

Techniques		\$/place/year	\$/t pig prod./year
Feeding	Low protein diet + amino acids	0.5 - 3.4	1.7 - 11.6
Housing			
Gestating sows	Reduced manure pit	7.5 - 8.9	2.8 - 3.9
	Littered system	62.5 - 105.7	23.5 - 39.7
Lactating sows	Manure pan underneath	23.0 - 48.9	2.9 - 6.0
Growers-finishers	Sloped manure channel	0.9 - 10.1	3.3 - 34.6
	Partially slatted floor	0 - 5.6	0 - 19.3
		\$/m^3/year	
Spreading (pig slurry)	Trailing shoe	1.2 - 1.8	15.1 - 23.1
	Band spreader	1.1 - 1.6	13.0 - 19.8
	Incorporation	0.3 - 0.8	3.8 - 10.0

Key Words: Cost, Ammonia Abatement, Pig

772 Influence of diet and genotype on performance of weanling pigs destined for natural label or commodity pork markets. A. F. Harper* and M. J. Estienne, *Virginia Polytechnic Institute and State University*, *Blacksburg*.

Diet formulation and pig genotype are important factors in the production of pork for niche markets. Weanling pigs (n = 60; 9.71 ± 0.03 kg BW) were used to assess diet and sire breed effects on performance. Diet treatments were a 2-phase series of diets acceptable for natural pork labeling (no antibiotics or blood or meat products) or a 2-phase series of conventional nursery diets (contained blood and meat products in phase 1 and medicated with 27 ppm carbadox throughout). The factorial treatments were: the natural diet fed to Berkshire-sired pigs, the natural diet fed to terminal Hampshire-sired pigs, the conventional diet fed to Berkshire-sired pigs, and the conventional diet fed to terminal Hampshire-sired pigs. There were 5 pens of 3 pigs per pen for each treatment. Feed and water were provided ad libitum. Pig BW and feed intake were determined at d 9 (phase 1) and d 34 (phase 2). During phase 1 pigs fed the natural diet had lower ($P < 0.01$) ADFI (201 vs. 280 ± 15 g) and ADG (156 vs. 204 ± 9 g) than pigs fed the conventional diet. Over the 34-d trial there was no main effect difference ($P > 0.24$) in ADFI (803 vs. 844 ± 25 g), ADG (436 vs. 453 ± 10 g) or G:F (0.55 vs. 0.54 ± 0.01) for the pigs fed the natural or conventional diets, respectively. During phase 1 performance traits were not different ($P > 0.19$) between Berkshire- and Hampshire-sired pigs, but for the entire trial ADG tended be greater for Berkshire-sired pigs (472 vs. 418 ± 17 g; $P = 0.11$). An interaction ($P < 0.05$) between diet and genotype was observed for ADG during phase 1. Hampshire-sired pigs fed the natural diet had lower ADG (123 ± 17 g) relative to Berkshire-sired pigs fed the natural diet (188 ± 17 g) or Berkshire-sired (208 ± 17 g) or Hampshire-sired (199 ± 17 g) pigs fed the conventional diet. Conventional diets produced superior growth performance during phase 1 but this advantage was not maintained for the entire 34-d nursery period. The interaction in ADG suggests that Berkshire-sired pigs may have greater potential to maintain a high level of performance than certain terminal-line sired pigs when less complex, antibiotic-free starter diets are fed.

Key Words: Pigs, Diet, Genotype

773 Loading gantry versus traditional chute for the finisher pig: Effect on transportation and packing plant losses. N. Berry*, A. Johnson, K. Stalder, T. Baas, and L. Karriker, *Iowa State University*, *Ames*.

Pig mortalities from the farm to the harvest facility have been estimated to cost the U.S. swine industry over 55 million dollars annually. The objective of this study was to determine if chute design affects the incidence of dead, injured or stressed pigs upon arrival at the packing plant. A total of 456 semi loads of crossbred finisher pigs (117.43 kg) from a single finishing site were collected. A two by two factorial arrangement of treatments was compared, with loading systems (prototype loading gantry [P] vs. traditional chute [T]) and pull (first pigs marketed or first pull [FP] vs. last pigs marketed or closeout [CO]). Pigs were loaded using standard procedures for pig handling and transportation. Performance measures evaluated were dead on arrival (DOA), stressed on arrival (SOA), crippled on arrival (COA), dead in plant (DIP), stressed in plant (SIP) and crippled in plant (CIP). Data were analyzed using PROC Glimmix of SAS where dependent traits were evaluated with a full model including load chute, load crew, barn, pull, load time per pig, travel time, hauler, average live weight, kill date, week, and month fixed effects and a harvest day random effect. All non-significant sources of variation were removed from the final analyses models. For all performance measures there was no loading systems (P vs. T) effect (P>0.05). A pull effect (P<0.01) for SOA's with more occurring at closeout than first pull (0.30 vs. 0.16) was identified. Month of marketing was a source of variation (P<0.05) for SOA, DIP and SIP. Pull by load chute was a source of variation (P<0.01) for DIP's with CO pulls from the P chute having fewer DIP's when compared to CO pulls from the T chute. Fewer DIP's were

observed in CO pulls from the T chute when compared to FP from the T chute. A trend (P=0.06) for DOA's was seen between loading systems and pull. Additional work is needed to further characterize the role that loading system plays in the incidence of both the fatigued and dead pig during transportation and at the packing plant.

Key Words: Finisher Pig, Loading Gantry

774 Effect of autosort technology on pork production measures. J. M. Suchomel*, A. E. DeDecker, and J. L. Salak-Johnson, *University of Illinois*, *Urbana*.

Limited data exist about the impact autosort technology, a relatively new management tool, has on pig performance measures. The objective of this study was to determine the effects that 3 different pen layouts incorporating autosort technology had on wean-to-finish performance. This experiment was replicated twice with 622 ±13 cross-bred pigs per treatment in trial 1 and 615 pigs per treatment in trial 2. Treatments were food court (FC), water court (WC) and fast lane (FL) autosort floor layouts or conventional large pen (CV; control). Resources were zoned off in autosort treatments with 40% of total floor space zoned for food and water in (FC) and 20% zoned for water in (WC), respectively. For the (FL), food and water were distributed equally between 8 zones with 12.5% floor space per zone. Weights from automated scale units were recorded on a regular basis and production data was collected at slaughter. Performance measures included: mortality, average daily gain (ADG), days to market (DTM), and hot carcass weight (HCW) at market for the first two sorts from each treatment. In trial 1, carcass lean % data was also recorded from the first sort. Data were analyzed with Proc GLM procedure and Chi-Square in SAS. Pig ADG and DTM were similar among treatment groups. Pig HCW was similar across sorts. However, HCW overall (P< 0.0001) was less for the FC and WC pigs compared with the CV pigs. Pig HCW was greater for the FL pigs (P= 0.0002) than CV in trial 1, but the WC, FL, and FC (P< 0.001) were less than the CV pigs in trial 2. Percentage of pigs that died prior to shipping was greater in the FC (P = 0.01) and FL (P< 0.0001) treatments than CV pens. Percent carcass lean was similar among treatments. These data indicate that pig performance is similar among these specific autosort layouts when compared to large conventional pens but it seems possible that these systems can be improved to achieve the potential benefits of autosort technology. The food court, at this point, may be the best layout to attempt to modify in order to realize those potential benefits.

Key Words: Pig, Autosort, Production

775 Characterization of the acute-phase protein response following vaccination and weaning in beef steers. R. F. Cooke*[1], D. B. Araujo[1], G. L. Stokka[2], and J. D. Arthington[1], [1]*University of Florida - RCREC*, *Ona*, [2]*Pfizer Animal Health*, *New York, NY*.

The objectives of this study were to assess the acute-phase protein response of beef steers following vaccination with two different vaccines and to determine if this response is additive to the weaning process. On d 0, 48 steers (Brahman × British; avg. age = 7 mo) were randomly assigned to one of six treatments in a 2 × 3 factorial arrangement, including: weaning (WN) vs. no weaning (NW), and vaccination with One Shot® (1S; 2 mL s.c), UltraBac® 7 (U7; 5 mL s.c.), or saline control (Control; 5 mL s.c.). Blood samples were collected on d 0, 1, 3, 5, 7, 10, 14, and 21, relative to weaning and vaccination, for determination of plasma fibrinogen, ceruloplasmin, haptoglobin, and acid-soluble protein (ASP) concentrations. During the course of the study, free-choice hay and a grain-based supplement (< 4.5 kg/d) were offered to WN steers, while NW steers remained with their dams. Compared to NW, WN had greater (P<0.05) ceruloplasmin concentrations on d 3, and greater haptoglobin concentrations on d 3 (P<0.01) and 5 (P<0.05) (weaning treatment × day interactions; P<0.01). Among WN steers, average ceruloplasmin concentration was greater (P<0.05) for 1S vs. Control and U7. Vaccination treatment × day interactions were detected (P<0.01) for fibrinogen, ASP, and haptoglobin. Fibrinogen concentrations were greater (P<0.01) on d 1, 3, and 5, and tended (P<0.10) to be greater on d 7 for 1S vs. Control and U7. Concentrations of ASP were greater (P<0.01) on d 3 and tended (P<0.10) to be greater on d 5 for 1S vs. Control and U7. Haptoglobin concentrations were greater (P<0.01) for 1S vs. Control and U7 on d 1 and 3, but greater (P<0.05) for U7 vs. Control and 1S on d 5. Data from this study imply that animals vaccinated with One Shot® experience a greater inflammatory response compared to animals vaccinated with UltraBac® 7 and saline control, and this response mainly occurs during the 5 d following vaccination. In addition, additive effects of vaccination on weaning were only observed for plasma ceruloplasmin concentrations.

Key Words: Acute-Phase Proteins, Steers, Vaccination

776 Efficacy of chlorate against *E. coli* O157:H7 and *Salmonella* Typhimurium in bovine feedlot soil mixture. C. E. Oliver*[1], B. K. Magelky[2], M. L. Bauer[1], J. S. Caton[1], H. Hakk[2], G. L. Larsen[2], R. C. Anderson[3], and D. J. Smith[2], [1]*North Dakota State University*, *Fargo*, [2]*USDA/ARS Biosciences Research Laboratory*, *Fargo, ND*, [3]*USDA/ARS Food & Feed Safety Research Unit, Southern Plains Agricultural Research Center*, *College Station, TX*.

Our aim was to determine if chlorate, temperature, or atmosphere affected pathogen viability in feedlot soil. Aliquots (1 g) of dried bovine feces/soil mixture (75:25 w:w) and 1 mL bovine urine were incubated in 10 or 20 mL glass serum vials with chlorate (0, 17, 33, or 67 ppm), at 6, 20, or 30°C, under aerobic or anaerobic conditions. Each vial was inoculated with 1 mL of a fresh bovine fecal supernatant mixed with overnight cultures of *E. coli* O157:H7 strain 933 (EC) and *Salmonella enterica* Typhimurium DT104 (ST) in an 8:1:1 ratio. Aerobic vials were weighed daily and evaporative loss replaced with distilled water. Anaerobic vials were capped with a butyl stopper and aluminum seal. Samples were collected on d 0, 0.5, 1, 3, 7, 14, 21, and 28; serially diluted in phosphate buffered saline; and plated on MacConkey and XLT-4 agars. Plates were incubated at 39°C for 24 h and pathogens were counted. A second study was performed using sterile feedlot soil and fecal supernatant, so that added EC and ST were the only live bacteria present in the cultures. In the first study, EC was not detected in any aerobic cultures by d 3 at 20°C and by d 1 at 30°C. At 6°C, EC was not detected at 67 ppm chlorate by d 21, but persisted through d 28 in the remaining cultures at $\log_{10}$ 4 to 5.5 bacteria/mL culture. Aerobic cultures at all temperatures had no detectable ST by d 21 to 28. Pathogens in anaerobic cultures were detected in nearly all cultures at d 28, however, bacterial counts declined over time. In sterilized feedlot soil, results were similar. In both studies, there was no effect of chlorate on pathogen viability at the higher temperatures, but at 6°C there was an apparent chlorate dose–dependent decline in EC

counts. Chlorate may be effective in preventing pathogen persistence in feedlot soils at ~6°C temperatures.

777 Effects of maternal nutrition and selenium supply on postnatal organ mass: Evidence for developmental programming in lambs. J. S. Caton*[1], J. J. Reed[1], T. L. Neville[1], K. A. Vonnahme[1], P. P. Borowicz[1], J. B. Taylor[2], D. A. Redmer[1], J. S. Luther[1], C. J. Hammer[1], K. R. Carlin[1], and L. P. Reynolds[1], [1]*Center for Nutrition and Pregnancy, Animal and Range Sciences Department, North Dakota State University*, *Fargo*, [2]*USDA-ARS, U. S. Sheep Experiment Station*, *Dubois, ID*.

To examine effects of maternal nutrient restriction or excess and dietary Se on postnatal organ mass in the lamb, 82 pregnant Rambouillet ewe lambs (52.2 ± 0.8 kg) were allotted randomly to one of 6 treatments in a 3 x 2 factorial design. Groups included plane of nutrition (60% [RES], 100% [CON], and 140% [HIGH] of requirements) and dietary levels of Se (adequate Se [7.4 µg/kg BW] vs. high Se [85 µg/kg BW]; from Se enriched yeast). Selenium treatments were initiated at breeding and nutritional treatments on d 40 of gestation. Pelleted diets were fed once daily (36.5% beet pulp, 22.3% alfalfa meal, 16.2% corn, 18% soybean hulls, and 7.0% soybean meal; 14.4 % CP, 2.63 Mcal ME/kg; DM basis). At parturition, lambs were removed from the ewes before nursing and provided artificial colostrum for the first 20 h and were maintained on common management and diets until necropsy at approximately 5 mo of age. Live BW, hot carcass weight, and dressing percent were not affected ($P > 0.26$). Lamb pancreatic mass (g) was reduced ($P = 0.06$) in RES and HIGH compared with CON, as was blood mass (g and g/kg of empty BW; $P < 0.08$). Mass of the reticulum (g) was also reduced ($P = 0.10$) by in lambs from the RES and HIGH compared with CON ewes. In the lambs, maternal Se supplementation increased ($P < 0.01$) mass (g and g/kg empty BW) of the ovaries, decreased ($P < 0.09$) mass of heart and kidney (g/kg empty BW), and increased ($P = 0.04$) total visceral adiposity compared with adequate Se. Maternal nutrition by Se interactions were observed ($P < 0.06$) for omasum, small intestine, ileum and lungs. These data provide strong evidence for developmental programming of internal organ mass in offspring from pregnant ewes receiving various nutritional levels and supplemental Se.

Key Words: Maternal Nutrition, Selenium, Fetal Programming

778 Effects of maternal nutrition and selenium supply on ewe and lamb performance. T. L. Neville*[1], J. J. Reed[1], K. A. Vonnahme[1], P. P. Borowicz[1], J. B. Taylor[2], D. A. Redmer[1], J. S. Luther[1], C. J. Hammer[1], G. P. Lardy[1], L. P. Reynolds[1], and J. S. Caton[1], [1]*Center for Nutrition and Pregnancy, Animal and Range Sciences Department, North Dakota State University*, *Fargo*, [2]*USDA-ARS, U. S. Sheep Experiment Station*, *Dubois, ID*.

To examine effects of maternal nutrient restriction or excess and dietary Se on ewe and lamb performance, 82 pregnant Rambouillet ewe lambs of equivalent BW (52.2 ± 0.8 kg) and condition score (BCS; 3.0 ± 0.05) were allotted randomly to one of 6 treatments in a 3 × 2 factorial design. Groups included plane of nutrition (60% [RES], 100% [CON], and 140% [HIGH] of requirements for gestating ewes) and dietary levels of Se (adequate Se [7.4 µg/kg BW] vs. high Se [85 µg/kg BW]; from Se enriched yeast). Selenium treatments were initiated at breeding and nutritional treatments on d 40 of gestation. All diets were fed once daily in a complete pelleted form (36.5% beet pulp, 22.3% alfalfa meal, 16.2% corn, 18% soybean hulls, and 7.0% soybean meal; 14.4 % CP, 2.63 Mcal ME/kg; DM basis). At parturition, lambs were removed from the ewes before nursing and provided artificial colostrum for the first 20 h, after which they were fed milk replacer. At parturition, ewe BW and BCS were least ($P < 0.01$) in RES, intermediate in CON, and greatest in HIGH (53.9, 67.3, and 76.5 ± 1.4 kg and 1.60, 2.53, and 3.61 ± 0.10, respectively), as were ewe ADG and efficiency ($P < 0.01$). Ewe BW, BCS, ADG, gain efficiency, and gestation length were not altered by Se supplementation. Gestation length was reduced ($P < 0.01$) in HIGH compared with CON and RES. At birth, lamb BW, curved crown rump length, and heart girth were lower ($P = 0.01$) in RES and HIGH compared with CON. Weaning weight 8 weeks postpartum was less ($P = 0.01$) in lambs from RES ewes compared with those from CON and HIGH. Birth and weaning weight were unaffected by Se supplementation. These data indicate that maternal plane of nutrition but not supplemental Se affects the BW, BCS, and gestation length of the ewes and the birth and weaning weights of the resulting lambs.

Key Words: Birth Weight, Maternal Nutrition, Selenium

779 First-lactation milk production for cows fed control or intensified milk replacer programs as calves. J. K. Drackley*, B. C. Pollard, H. M. Dann, and J. A. Stamey, *University of Illinois*, *Urbana*.

Potential long-term effects of early-life plane of nutrition were quantified in 2 trials. Female Holstein calves housed in individual hutches were fed milk replacers in either conventional limit-fed (C: 22% CP, 20% fat; 1.25% of birth BW) or intensified programs (I: 28% CP, 20% fat). The 2 trials differed only in how I was increased after wk 1. Calves were weaned at 5 wk (C) or 6 wk (I). Calves were housed in groups by treatment from wk 9 to 12, then combined under common group management. Growth results were reported previously (Pollard et al., 2003, J. Dairy Sci. 86(Suppl. 1):174). Calves fed I had greater (P<0.001) ADG to wk 4 (Trial 1: 0.30 vs. 0.71 kg/d; Trial 2: 0.36 vs. 0.72 kg/d for C and I, respectively) and wk 8 (Trial 1: 0.56 vs. 0.69 kg/d, P<0.01; Trial 2: 0.59 vs. 0.67 kg/d, P=0.08). However, because growth slumped around weaning for I calves, BW at wk 12 did not differ (Trial 1: 103.7 vs. 104.2 kg, P=0.93; Trial 2: 103.9 vs. 97.2 kg, P=0.11). Lactation data from the 2 trials were pooled and analyzed using the Mixed procedure (SAS) with a model containing month of calving, age at calving, and lactation length as covariates; diet, trial, and the interaction were fixed effects. Age at first calving differed (P<0.01) between trials (Trial 1=25.9 mo; Trial 2= 24.1 mo) but was not affected by diet. Post-calving BW did not differ between trials or diets (mean 568 kg). A total of 10, 10, 18, and 14 heifers completed lactation records for C and I diets in Trials 1 and 2, respectively. Actual 305-d milk was greater (P<0.01) for I calves (Trial 1: 9,245 vs. 10,577 kg; Trial 2: 8,796 vs. 9,138 kg). Protein yield (305 d) was greater (P<0.001) for I calves but milk fat yield did not differ. Lactation length tended to be greater (P=0.07) for I calves (358 vs, 407 d). Total lactation milk yield was greater (P<0.01) for I calves (Trial 1: 11,232 vs. 12,917 kg; Trial 2: 10,824 vs. 11,243 kg; trial x diet, P=0.08). Intensified early nutrition increased early growth rates but greater BW was not sustained through wk 12; nevertheless, first-lactation milk yield was increased.

Key Words: Calf Nutrition, Lactation, Calves

780 Effect of mineral supplementation with MIN-AD during the transition period on cow health and production performance. J. E. Nocek*[1], R. G. Hinders[2], C. J. Sniffen[3], G. A. Nunnery[4], and M. B. Crombie[4], [1]*Spruce Haven Farm and Research Ctr*, *Auburn, NY*, [2]*Hinders Nutritional Consulting*, *Acampo, CA*, [3]*Fencrest*, *Holderness, NH*, [4]*MIN-AD, Inc.*, *Amarillo, TX*.

The objective of this study was to determine the effect of partial replacement of MgO and sodium bicarbonate with MIN-AD in the ration of early lactation cows on milk yield, composition and health. One hundred and four multiparous cows were group housed pre- and postpartum in separate pens containing approximately 70cows/group. They were assigned to the following treatments based on parity and previous lactation 305ME: Control: Cows received sodium bicarbonate at 1.0% of DM upon calving, MIN-AD: Cows received MIN-AD (MIN-AD, Inc., Amarillo, TX) at 0.5% DM for the entire study. At calving, these cows also received sodium bicarbonate at 0.5% of ration DM. Cows started the experimental period 21d prior to expected calving and remained on treatment for 10 wk during the subsequent lactation. There was no significant effect of MIN-AD on health incidence measured. However, there was a tendency for reduced displaced abomasums (P = 0.16, 7.7 and 1.9%) and clinical milk fever (P=0.15, from 3.8 % and 0%) for cows supplemented with MIN-AD. Group dry matter intakes were similar between treatments during the pre- and postpartum periods. Milk yield was higher (P = 0.001) for cows supplemented with MIN-AD as compared to control cows (42.4 and 44.1 kg/d for control and supplemented respectively). There was no treatment effect on milk fat percentage, yield or protein percentage. Protein yield and MUN were higher (P=0.03 and 0.02 respectively) for cows supplemented with MIN-AD, and lactose was higher (P=0.01) for control cows. Body condition scores were not affected by MIN-AD supplementation. Partial replacement of MgO and sodium bicarbonate with MIN-AD during the transition period did not influence health but increased milk production and protein yield.

Key Words: Dairy cattle, Transition, MIN-AD

781 Effects of twin pregnancy and dry period feeding strategy on milk production, energy balance and metabolic profiles in Holstein cows. N. Silva del Río*, R. R. Grummer, and P. M. Fricke, *University of Wisconsin*, *Madison*.

To evaluate the interaction of pregnancy type [singleton (S) vs. twin (T)], and dry period feeding management [transition diet (NEL=1.54 Mcal/kg) for 3 (3TR) vs. 8 (8TR) wk before expected calving date (ECD)], multiparous (n=39) and primiparous (n=8) Holstein cows were used in a 2x2 factorial randomized complete block design. Our hypothesis was that 8TR would improve metabolic status and lactation performance for T but not S cows. All cows were feed a late lactation diet (NEL=1.58 Mcal/kg) 90 to 60 d before ECD and the same early lactation diet (NEL=1.71Mcal/kg) after calving. At dry-off, cows were randomly assigned to 8TR or a far-off diet (NEL=1.32 Mcal/kg) for 5 wk followed by 3TR. DMI was measured daily, milk components were analyzed weekly, and blood samples were collected weekly from 90 d before ECD to calving. Postpartum, blood was collected from wk 1 to 5, and wk 7 and 10. Liver biopsies were performed about 3 wk before ECD and 1 and 35 d after calving. All data were covariately adjusted and statistically analyzed in a repeated measures design using the MIXED procedure of SAS. The least square means for main effects and their significances are described in the table below. Contrary to our hypothesis, no interaction (P>0.05) of dry period feeding management and pregnancy type was detected either prepartum or postpartum; however, feeding a diet moderate in energy throughout the dry period was associated with increased milk production. Supported by USDA NRI grant number 2002-35204-12351

Table 1.

	Diet		Calf		Diet	Calf
Response Variable	3TR	8TR	S	T	*P*	*P*
Prepartum						
DMI (kg)	11.8	13.3	12.9	12.1	0.03	0.22
EB (Mcal/day)	1.4	4.2	4.7	0.9	0.01	<0.01
BHBA (mg/dL)	5.2	5.9	5.3	5.9	0.02	0.06
NEFA (µEq/L)	198	168	150	216	0.02	<0.01
Liver TG (µg/µg DNA)	1.4	0.9	0.9	1.1	0.01	0.07
Postpartum						
DMI (kg)	21.6	22.1	21.5	22.2	0.5	0.31
3.5% FCM (kg)	43.8	49.2	47.8	45.3	0.03	0.30
EB (Mcal/day)	-2.5	-5.5	-5.8	-2.2	0.02	0.01
BHBA (mg/dL)	6.4	7.8	7.6	6.6	0.09	0.33
NEFA (µEq/L)	393	461	447	406	0.06	0.02
Liver TG (µg/µg DNA)	3.6	3.1	4.1	2.6	0.52	0.04

Key Words: Twinning, Prepartum Diet, Lactation Performance

782 Effect of botanical extracts (Queen of Calves) on the growth, development and weaning age of calves. J. K. Margersion* and R. W. Reynolds, *Massey University*, *Palmerston North, New Zealand*.

This research assessed the effect of feeding botanical extracts (Queen of Calves) with milk on; calf growth, development, feed intake and weaning age. Sixty calves were selected at random and allocated (48 h) according to sex, breed and live weight to one of three treatments; 4 l /h/d of whole milk (M); 4 l/h/d whole milk 4 l, plus 200 g botanical extracts (M+B); 2 l/h/d whole milk, plus 200 g botanical extracts (0.5M+B). Calves offered M+B had significantly higher live weight gain (g/h/d): M; 648^{b}, M+B; 755^{a}, 0.5M+B: 729^{ab} (sem 31.3), hip height (m): M; 1.81^{b}, M+B; 1.83^{a}, 0.5M+B; 1.82^{ab} (0.43) compared with M, there was no difference between calves offered 0.5M+B and M. All calves offered botanical extracts had higher hip width (mm): M; 18.7^{b}, M+B; 19.5^{a}, 0.5M+B; 19.0^{b} (0.17) compared with M. Days to weaning from milk (M; 79.2^{a}, M+B; 70.6^{b}, 0.5M+B; 74.7^{a} (1.97) and weaning from concentrated feed (M; 87.3^{a}, M+B; 79.0^{b}, 0.5M+B; 82.5^{a} (1.10) were significantly lower for calves offered M+B and were not significantly different for calves offered 0.5 M+B with 4 l milk. Concentrated feed intake was not significantly different (kg/h): M; 103.8, M+B; 97.3, 0.5M+B; 110.3 (4.34). Calves offered milk with botanical extracts had significantly higher growth rates, hip height and width, and weaned significantly sooner. Calves offered 2 l/h/d milk with botanical extracts had similar growth rates compared with calves offered 4 l/h/d milk.

Key Words: Calves, Growth, Development

783 Impacts on growth of beef cattle due to long-term copper deficiency are further exacerbated in the presence of high dietary manganese. S. L. Hansen*, L. R. Legleiter, R. S. Fry, K. E. Lloyd, and J. W. Spears, *North Carolina State University*, *Raleigh*.

A study was conducted to evaluate the effects of long-term copper (Cu) deficiency, either alone or in the presence of high manganese (Mn), on the performance of beef calves. Twenty-one Angus calves were born to cows that had been on one of the following treatments for at least 410 days by calving: 1)10 mg Cu/kg DM from tribasic copper chloride in addition to the basal diet (analyzed 7 mg Cu/kg DM; +Cu), 2) no supplemental Cu and 2 mg molybdenum (Mo)/kg DM (-Cu), and 3) no supplemental Cu, 2 mg Mo/kg DM and 500 mg Mn/kg DM from manganese sulfate (-Cu+Mn). After weaning, calves remained on the same treatments as their dams and were group fed by treatment for a period of 33 days before being individually fed via Calan gate feeders through a 136 day growing phase. The average calf age at weaning was 180 days. Liver biopsies taken when calves were approximately 160 days of age indicated that calves fed low-Cu diets were below the threshold for Cu deficiency (7 and 4 mg Cu/kg DM for -Cu and -Cu+Mn, respectively). Copper adequate calves were heavier (237 kg; $P < 0.05$) at weaning than those fed -Cu (199 kg) or -Cu+Mn (186 kg) diets. Daily gains from birth to weaning were greater ($P < 0.01$) for +Cu calves (1.09 kg) than for -Cu (0.88 kg) and -Cu+Mn (0.82 kg) calves. During the growing phase, ADG was not different between +Cu (1.08 kg) and -Cu (1.05 kg) calves, but was lower (0.86 kg; $P < 0.05$) in -Cu+Mn calves. Dry matter intake during the growing phase did not differ among +Cu (7.36 kg) and -Cu (7.08 kg) calves. However, DMI was lower ($P < 0.01$) in -Cu+Mn calves (5.39 kg) when compared to -Cu calves. Feed efficiency during the growing phase did not differ among treatments. Findings from this study indicate that a low-Cu diet fed to calves prior to weaning adversely affects performance. In addition, the presence of high Mn in diets of Cu-deficient calves further exacerbates the effects of low Cu on growth.

Key Words: Cattle, Copper, Manganese

784 Effects of high B-vitamin supplementation on measures of health and performance of veal calves. D. Wood*[1], J. Sowinski[1], and N. Keith[2], [1]*Animix*, *Juneau, WI*, [2]*Keith Associates*, *Springfield, MO*.

An experiment was conducted to determine effects of enhanced B-vitamin fortification on calf health and performance. Auction sourced Holstein bull calves (n = 110; initial BW = 46 kg; ~1 wk of age) were transferred to the facility, and randomly placed into individual raised, slatted veal stalls. All calves were provided starter formula (22% CP and 16% fat) composed of liquid fat, whey, skim milk, & spray dried plasma, and transitioned to a veal finisher (19.5% CP and 17% fat) at ~40 days. Formulas were fortified with a typical B-vitamin containing, dispersible premix. Calves were randomly assigned to receive one of two treatments, 1) Increased B-vitamin fortification: 9 × B1, B2 and B6; 8 X pant. acid, 6X B12, 7× biotin, 3× folic acid, 2× choline and 4× niacin (B-vit; n = 55), 2) no added supplement, only basal formula (Control; n = 55). Individual calf BW was determined on d 11 and d 62 and individual hanging carcass weights were determined at slaughter. Calf ADG from day 11 – 62 did not differ (P = 0.50) among treatments (0.95 and 0.97 kg/d for Control and B-vit.-Fortified, respectively). Calf ADG from day 11 – 143 (market) did not differ (P=0.75). Individual antibiotic treatments day 11 – 63 were reduced from 1.52 / calf in control to 0.63 / calf in B-vit. (P = 0.101). Incidence of feed refusals day 11 – 63 reduced 23% (P = 0.35) and percentage of calves treated was reduced from 41.8% in control to 25.5% in B-vit (P=0.07). Incidence of re-treatment day 11 – 63 was reduced from 29% in control to 12.7% in B-vit (P=0.035). Mortality and culls to 9 weeks was 1.8% B-vit and 5.3% Control. Weeks 10 – 23 reported no diff. in ADG (1.49 and 1.50 kg/d for Control and B-vit, respectively, P=0.93) or feed refusals (P=0.91). 4 calves (7.2%) died of disease in both treatments during week 10 - 23. Individual antibiotic treatments week 10 – 23 were reduced from 1.79 / calf in B-vit to 1.22 in control (P=0.254). No difference was noted in carcass color or confirmation (P=0.36). Under the conditions reported in this study, additional B-vitamin supplementation improved measures of calf health to week 9 but did not improve health parameters week 10 – 23.

Key Words: Calf, B Vitamin, Vitamin

Ruminant Nutrition: Protein and Fiber Digestion

785 Protein requirements of Nellore bulls, steers and heifers in Brazil. P. V. R. Paulino*[1], S. de C. Valadares Filho[1], M. A. Fonseca[1], K. A. Magalhães[1], M. I. Marcondes[1], M A. de Souza[1], E. Detmann[1], R. F. D. Valadares[1], and R. D. Sainz[2], [1]*Universidade Federal de Viçosa*, *Viçosa, MG, Brazil*, [2]*University of California*, *Davis*.

The objective in this trial was to determine the protein requirements of Nellore bulls, steers and heifers, reared under the same experimental conditions. Forty–seven animals were used (16 bulls, 15 steers and 16 heifers), being fed in individual pens for 112 days, and slaughtered at the end of this period. Eleven animals (4 bulls, 3 steers and 4 heifers) were slaughtered at the beginning of the trial, composing the reference group, which was used to estimate the initial body composition of the animals. The remaining animals were randomly assigned to 6 treatments, in a factorial design, 3 × 2 (3 sexual classes and 2 concentrate allowance levels), with four replicates per treatment. Four animals of each sexual class were designated to the maintenance group. The concentrate allowance levels used corresponded to the allowance of 0.6 or 1.2% of the body weight. The diets were formulated to be isoproteic, with corn silage as the source of roughage. The protein content retained in the body was estimated by a regression equation of the logarithm of the body content of protein on the logarithm of the empty body weight (EBW). The net requirements of protein for 1 kg of empty body gain (EBG) were estimated as the derivative of the regression equation described above. The net protein requirements of EBG decreased as the live weighted increased, being greater for the bulls, intermediate for the steers and lower for the heifers. The retained protein (RP) can be estimated by the equations: RP = 14,78 + 175,86 * EBG – 2,95 * RE (bulls), RP = 25,62 + 139,81 * EBG – 7,43 * RE (steers); RP = 18,13 + 177,27 * EBG – 16,57 * RE (heifers). Bulls had higher net requirements of protein for empty body gain in relation to the steers and heifers, being lower for the heifers in relation to the steers, reflecting the differences observed in the body composition among the three sexual classes. The estimated total requirements of crude protein, for finishing of Nellore cattle, were 12.92; 11.14 and 10.08% of the total dry matter of the diet, for bulls, steers and heifers, respectively.

Key Words: Beef Cattle, Zebu, Protein

786 Digestibility of cottonseed with Tifton 85 hay fed free-choice to beef steers. G. M. Hill*[1], M. H. Poore[2], and B. G. Mullinix, Jr.[1], [1]*University of Georgia*, *Tifton*, [2]*North Carolina State University*, *Raleigh*.

Whole cottonseed (WCS) is a supplement for wintering beef cows, but few reports indicate effects of free-choice feeding of WCS. Large beef steers (n=28; 417.2 ± 36.1 kg initial BW) were ranked by BW, randomly assigned to four treatments (7 steers each), and individually-fed diets for 17 d. Dietary treatments included free-choice hay (Tifton 85 bermudagrass; 12.4% CP, 42.6% ADF, 76.8% NDF) and minerals. Dietary treatments included hay with Control supplement [C; 75% ground corn, 25% cottonseed meal (19.9% CP, 14.2% NDF), fed at 2.5 kg/steer daily], or WCS (DM basis: 22.4% CP, 39.2% ADF, 54.7 % NDF, 18.0% crude fat) fed at three levels (LCS, WCS at 0.25 % initial BW; MCS, WCS at 0.5 % initial BW; and FCS, WCS fed free-choice). Chromic oxide (10 g/steer daily; d 8 to d 17) was fed as an indigestible marker, mixed with C supplement, or fed in a carrier (corn=0.25 kg/steer daily) for CS treatments. Fecal samples (11/steer, d 13 to d 17) were analyzed to determine apparent digestion of dietary nutrients. Dietary CP and crude fat (% of DM) based on DMI for C, LCS, MCS and FCS, respectively, were: 14.4, 2.1; 13.6, 3.7; 14.8, 5.7; and 14.5, 5.2. Breed type (BT) of steers [BT1, Angus (n=7) and Angus crossbred (n=8); BT2, Angus x Hereford (n=8); BT3, Hereford steers (n=5)] was used as a covariate ($P > 0.20$; Table). Hay DMI (Table) was reduced for MCS and FCS, and dietary DMI was similar for LCS and FCS, both lower than C or MCS. Inconsistent WCS intake by FCS steers resulted in lower WCS intake and dietary DMI than for MCS. Digestibility of OM was lowest for FCS, intermediate for LCS and MCS; and, ADF and NDF digestibility declined with increasing dietary WCS. The short duration of the trial contributed to DMI adjustment to WCS in MCS and FCS diets.

Table 1.

Item	Control	LCS	MCS	FCS	SE	*P* <
Hay DMI, kg	6.61^{a}	6.49^{a}	5.89^{ab}	5.47^{b}	0.29	0.04
Supplemental DMI, kg	2.45^{a}	1.20^{c}	2.17^{ab}	1.91^{bc}	0.18	0.01
Dietary DMI, kg	9.09^{a}	7.71^{b}	8.10^{ab}	7.41^{b}	0.42	0.05
OM digestibility, %	79.08^{a}	76.50^{ab}	75.10^{bc}	71.70^{c}	1.32	0.01
CP digestibility, %	77.17	77.48	77.84	74.30	1.46	0.32
ADF digestibility, %	65.06^{a}	65.82^{a}	66.07^{ab}	57.46^{b}	2.04	0.03
NDF digestibility, %	74.04^{a}	75.02^{a}	71.41^{ab}	68.61^{b}	1.50	0.03

Key Words: Cottonseed, Steer, Digestion

787 Performance of beef heifers and digestibility of steers fed whole cotton seed, corn gluten feed and pigeon peas. V. A. Corriher*, G. M. Hill, S.C. Phatak, and B.G. Mullinix, Jr., *University of Georgia*, *Tifton*.

Exp.1: Yearling beef heifers were fed supplements including whole cotton seed [WCS; 1.36 kg/d; 92.6% DM, 22.5% CP, 18.1% crude fat], corn gluten feed [CGF; 1.59 kg/d; 88.2% DM, 22.1% CP], pigeon peas [PP; 1.59 kg/d; 88.9% DM, 21.5% CP], corn/soybean meal as a control [(70% corn, 30% SBM) C/SBM; 1.59 kg/d; 89.9% DM, 30.8% CP], and free-choice corn silage [28.6% DM, 8.3% CP, 39.1% NDF] in feedlot. Supplements contained Rumensin® (200 mg/animal daily) in both experiments. Heifers (n=56) were of Breed Type 1 (BT1, Angus=19, Angus × P. Hereford= 8) or Breed Type 2 (BT2, Brangus=13, Braford= 16). Heifers were ranked by BW (initial BW=249.27 ± 23.72 kg) within BT, and randomly assigned to dietary treatments for 57d. Initial and final BW were means of consecutive daily unshrunk BW. The ADG for heifers tended to be higher for pigeon peas (Table). However, DMI/gain tended to be higher for corn gluten feed compared with other supplements.

Exp.2: Yearling beef steers were fed the same supplements (C/SBM: 2.00 kg/d; WCS: 2.30 kg/d; CGF: 2.30 kg/d; PP: 2.00 kg/d) as in experiment 1, and free-choice bermudagrass hay [92.5% DM, 12.4% CP, 76.8% NDF]. Steers (n=28) were of Breed Type 1 (BT1, Angus=7, Angus X=8), Breed Type 2 (BT2, Angus × P. Hereford= 7, Simmental X=1) or Breed Type 3 (BT3, P. Hereford= 4, Hereford X=1). Steers were ranked by BW (initial BW=450.55 ± 28.21kg) within BT, and randomly assigned to dietary treatments for 14d. Initial and final BW were means of consecutive daily unshrunk BW. Chromic oxide (10g/steer daily, d 5 to d 14) was fed as an indigestible marker and mixed with supplement. Total DMI was higher for whole cottonseed. Crude protein, ADF and OM digestibility were higher for corn gluten feed. Higher digestibility, suggests greater nutrient availability of corn gluten feed for cattle.

Table 1.

Exp. 1	C/SBM	WCS	CGF	PP	SE	*P* <
57-d DMI, kg	5.24^{bc}	4.76^{c}	5.98^{a}	5.67^{ab}	0.16	0.03
57-d ADG, kg	0.93	0.79	0.89	1.01	0.10	0.53
DMI/gain	5.90	6.31	6.68	5.61	0.89	0.84
Exp. 2						
Total DMI, kg	6.86^{b}	7.44^{a}	6.90^{b}	7.03^{b}	0.12	0.01
Digest. OM, %	76.0^{b}	73.7^{a}	79.3^{a}	74.7^{bc}	0.77	0.01
Digest. CP, %	77.7^{b}	78.1^{b}	81.7^{a}	77.2^{b}	0.67	0.01
Digest. ADF, %	58.2^{bc}	60.1^{b}	65.3^{a}	55.7^{c}	1.46	0.01

Key Words: Steer, Pigeon Peas, Digestibility

788 The rumen passage rate of forage NDF is highly associated only to the level of intake of dietary NDF. A. Cannas*[1], F. Boe[1], V. Giovanetti[2], E. Zerbini[3], and G. Molle[2], [1]*Dipartimento di Scienze Zootecniche, University of Sassari*, *Sassari, Sardinia, Italy*, [2]*Istituto Zootecnico e Caseario della Sardegna*, *Olmedo, Sardinia, Italy*, [3]*Cargill Animal Nutrition*, *Spessa, Italy*.

Cannas and Van Soest (2000) published a prediction equation in which the level of intake of dietary NDF was used to predict the rumen passage rate (Kp) of forages. The two variables were associated curvilinearly. Their prediction model included a second variable (dietary CP concentration) to account for the negative effect of rumen N shortage on Kp. However, in the literature many other independent variables have been used to predict Kp of dietary forages in ruminants. Thus, to elucidate which dietary and animal variables affects the rumen passage rate of forages, 40 dairy ewes (BW 46.8 kg ± 2.9 kg of s.d.) in mid-lactation (5 per treatment kept in metabolic cages) were fed ad libitum 8 different pelleted diets with a large range of variation in NDF concentration (23.9%-45.8%, DM basis). CP concentration was sufficiently high (on average 18.4 % DM) to rule out rumen shortages of nitrogen. Four of the 8 diets (range of NDF= 28.5%-45.8%, DM basis) were also given in rationed amounts (1.19% of BW, DM basis) to dry ewes. Rumen Kp passage rate was estimated supplying a single dose of dehydrated alfalfa, the common and only forage ingredient of all diets, marked with Yb.

Overall, DMI ranged from 489 to 2634 g/d (1.09%-5.77% of BW) and NDF intake from 117 to 1367 g/d (0.29%-2.87% of BW). The best predictor of rumen passage rate of forage NDF was the level of intake of dietary NDF. This predictor was both linearly and curvilinearly associated to forage NDF Kp with equally good statistics: Kp (%/h) = 1.82 × NDFI (% of BW) +2.27; r^2 = 0.76, P< 0.001; or Kp (%/h) = 4.23 $NDFI^{0.50}$ (% of BW), r^2 = 0.76, P< 0.001. The distribution of the residuals and the regressions based on the treatment means (Kp = 1.84 NDFI + 2.27, r^2 = 0.93, P< 0.001; or Kp = 4.29 $NDFI^{0.49}$, r^2 = 0.95, P< 0.001) seemed to slightly favour the curvilinear model. No other dietary or animal variables seemed to affect rumen Kp.

Key Words: Passage Rate, Prediction, Sheep

789 Meta analysis of rumen fill of cattle in relation to NDF intake and digestibility. D. J. Sauvant*[1] and D. R. Mertens[2], [1]*AgroParisTech*, *Paris, France*, [2]*US Dairy Forage Research Center*, *Madison, WI*.

Rumen fill is related to intake and ruminal digestion. Our objective was to explore if NDF relationships could be used to establish a rumen fill unit system. A database was compiled from 41 published experiments (n=164 treatments) where weights of dry matter (DMru) and NDF (NDFru) in the rumen were measured on various types of cattle. On a live weight (LW) basis, DMru averaged 1.76±0.30%LW and NDFru 0.99±0.22%LW. Dietary NDF averaged 36.0±9.7% of DM and NDF intake (NDFI) averaged 1.10±0.25%LW. As several experimental objectives were included in the database, only global regressions were evaluated. NDFru was related to the ruminal weight of total contents (TWru = 7.68 + 3.44 NDFru, n=156, rmse=1.51 %LW) or DM (DMru = 0.843 + 0.918 NDFru, n=164, rmse=0.22). The major variable related to NDFru was NDFI (NDFru = 0.461 + 0.484 NDFI, n=164, rmse=0.18). The residual variations of this equation (RESNDFru) were compared to variables other than NDFI, which might influence rumen fill. The ratio NDFru/NDFI, which is sometimes used as an index of rumen fill, was closely related with RESNDFru (RESNDFru = -0.76 + 0.83 NDFru/NDFI, n=159, rmse=0.08). There were no relationships between RESNDFru and DM intake; milk yield or composition; dietary NDF, CP, or starch; percentage of concentrate; mean particle size; chewing time or index; rumen fermentations; or fractional outflow rates of particles and liquid. In contrast, NDF digestibility (NDFD = 0.53±0.12) in the whole gut was negatively related with RESNDFru (RESNDFru = 0.988 NDFD - 1.67 NDFD2, n=121, rmse=0.16). Organic matter digestibility, which is correlated to NDFD, was also negatively linked with RESNDFru. For 43 treatments, in situ degradation of NDF of the forage was measured (NDFDis = 0.71±0.21). For these data a curvilinear regression was observed between RESNDFru and NDFDis (RESNDFru = - 1.08 + 4.90 NDFDis - 4.44 NDFDis2, n=43, rmse=0.13), the maximum value being achieved for NDFDis = 0.55. In conclusion, rumen fill is related primarily to NDF intake and secondly to its digestibility.

Key Words: NDF, Digestibility, Rumen Fill

790 Predicting ruminal passage rates of fiber fractions and starch in dairy cattle. J. A. Voelker Linton* and M. S. Allen, *Michigan State University*, *East Lansing*.

Passage rates of fiber fractions and starch are important factors determining ruminal nutrient digestion, microbial protein production, efficiency, and flow to the duodenum, and physical and metabolic satiety effects of a diet. Data obtained in our laboratory from 11 experiments utilizing the pool and flux method for estimating passage rates of digesta fractions were used to develop new regression equations predicting passage rates of indigestible NDF (iNDF), potentially digestible NDF (pdNDF), and starch. The data set included 254 animal-periods from multiparous lactating cows, 29 animal-periods from primiparous lactating cows, and 32 animal-periods from pregnant heifers. For passage rates, 95% confidence intervals were 1.23 to 5.31 h^{-1} for iNDF, 0.19 to 4.26 h^{-1} for pdNDF, and 3.44 to 33.9 h^{-1} for starch. Data were divided into two sets by randomly selecting 2/3 of the animal-periods from each study (210 records) for a database used to develop potential models, then assigning the remaining 1/3 of the animal-periods from each study (105 records) to a database used to validate potential models. Equations were developed using predictor variables that are available on farms. Predictors used in the regression equations included dietary concentrations of NDF, forage NDF (forNDF), and starch; 30-h in vitro NDF digestibility of forages; DIM and BW; intake of DM, NDF, and starch; and MY, milk fat concentration, and 3.5% fat-corrected MY (FCMY). The best predictions explained 68% (RMSE = 0.69), 53% (RMSE = 0.71), and 42% (RMSE = 5.87) of variation in passage rates of iNDF, pdNDF, and starch, respectively. Equations developed indicate that important predictors of passage rate include proportions of starch, NDF, and forNDF in the diet, intake of DM and starch, forage NDF digestibility, and MY or FCMY. Improving accuracy of predictions of passage rates will increase our ability to optimize ruminal fermentation, which can aid in optimizing DMI and nutrient utilization, thus reducing nutrient waste and increasing efficiency of milk production.

Key Words: Passage Rate, Fiber Fractions, Starch

791 Evaluation of counts of ruminal fibrolytic bacteria and enzyme activities in response to corn silage particle size in high-yielding dairy cows. Q. Zebeli*[1], V. Ölschläger[1], M. Tafaj[1], W. Vahjen[2], B. Junck[1], O. Simon[2], and W. Drochner[1], [1]*University of Hohenheim*, *Stuttgart, Germany*, [2]*Free University of Berlin*, *Berlin, Germany*.

This study examined the effects of particle size (PS) of corn silage (CS) on counts of selected fibrolytic bacteria and related enzyme activities in particulate or fluid ruminal digesta as well as on ruminal or total digestive tract fiber degradation in dairy cows fed TMR (40% CS, 10% hay and 50% cereal-based concentrate; DM basis) ad libitum. Four early-lactating (67 ± 8 DIM), rumen-fistulated Holstein cows were randomly assigned to incomplete block switch-back design in four 23-d periods to 1 of 3 diets (in average: 6.9 MJ NEL/kg of DM, 15% CP and 35% NDF in DM) differing in PS of CS: 14, 8.1 and 5.5mm (n=5/treatment). After a 12-d diet adaptation, digesta samples were collected from dorsal (particulate) and ventral (fluid) rumen sac, 1h before and 3h after morning feeding, and analyzed for pH, VFA, fibrolytic enzyme activities (by an agar-diffusion assay) and counts of fibrolytic bacteria using 16S rDNA quantification by real-time PCR. In general, the counts of total eubacterial cells, R. albus and R. flavefaciens were not affected by dietary PS (P>0.10), but the activities of CMCase, Glucanase, Galactanase and Xylanase quadratically increased with reducing PS (P<0.05). This was reflected in quadratically increased ruminal (in situ; P=0.07) or total tract (P<0.05) fiber degradation. Decreasing dietary PS did not affect ruminal pH (P>0.10), but increased ruminal C2/C3 ratio and C4 proportion (P<0.05).

Compared to fluids, the particulate digesta showed higher counts of fibrolytic bacteria and enzyme activities (P<0.05), whereas the latter were stronger enhanced by reducing dietary PS (P<0.05). Results of this study indicate that reducing PS of CS in a TMR has the capacity to increase fiber degradation in the rumen of dairy cows, particularly by stimulating the activities of fibrolytic enzymes rather than increasing the total count of fibrolytic bacteria.

Key Words: Ruminal Fermentation, Fibrolytic Bacteria, Dairy Cow

792 Nutrient digestibility and utilization in non-lactating fistulated cows fed diets containing ratios of untreated corn silage and Silo-King®treated alfalfa haylage. G. A. Ayangbile*, D. Spangler, D. Jones, and K. Thompson, *Agri-King, Inc.*, *Fulton, IL.*

It is a common practice in most dairy operations to feed diets consisting of two or more types of forages. On some farms, choices are made to ensile corn silage (CS) with or without any additive. However, it is of greater risk to ensile alfalfa without any additive. This study evaluates nutrient digestibility and utilization in non-lactating fistulated cows fed a TMR containing varing ratios of untreated CS and Silo-King® treated alfalfa haylage. Cows were arranged in a 4 × 4 latin square design. Diets consisted of a) 80% untreated CS and 20%, treated alfalfa haylage (80:20, CS/Hlg), b) 60:40, CS/Hlg, c) 40:60, CS/Hlg, and d) 20:80, CS/Hlg. Each period consisted of 16 d adaptation to diets, and 5-d collection. Total fecal collection was obtained per cow, and random spot urine samples were collected before (0 h) and after (4 h) feeding. Rumen fluid and blood samples were collected at 0 h and 4 h. The amino acids composition expressed as percentage of insoluble crude protein were higher for the TMR containing lowest inclusion of haylage. DMI ranged from 31.2 lb DM to 33.5 lb DM. Total DM fecal output (14.5 lb) was highest (P<.05) for 80:20, CS/Hlg and lowest (11.1 lb) for the 20:80, CS/Hlg. Digestibilities for DM, NDF, ADF, and starch were greater (P<.05) for 40:60 and 20:80, CS/Hlg TMR. Blood glucose (P<.05), ammonia, rumen valeric and isoacids were increased (P<.05) with higher haylage ratios in TMR. Results indicate the benefits of replacing portion of a diet containing an untreated corn silage with a higher level of treated alfalfa haylage. There were greater digestibility and utilization of organic and inorganic nutrients.

Key Words: Treated Forages, Fecal Output, Digestibility

Swine Species

793 Effects of a ground raw soybean diet on reproductive performance in gilts. D. Sykes*, K. Necaise, W. Brookshire, P. Gerard, F. Cunningham, M. Crenshaw, and P. Ryan, *Mississippi State University*, *Mississippi State*.

Raw soybeans contain high levels of phytoestrogens (i.e., genistein), which are bioactive compounds known to enhance ovarian function in sows, but little is known about the use of raw soybean diets on reproductive performance in gilts. Thus, the objective of this study was to examine the effects of a raw soybean diet on pregnancy outcome and weaning performance of gilts. To this end, prepubertal Yorkshire x Landrace gilts (n=20; BW 73.6 ± 1.1 kg; age 140 d) were assigned to balanced isonitrogenous (CP 14%) and isocaloric diets using either soybean meal (SBM; n=10) or ground raw soybean (RSB; n=10) as the protein (100%) supplement source. Gilts were housed in covered outdoor pens with ad libitum access to feed and water and monitored daily (from 160 d of age) for estrus using a teaser boar then bred by AI on the third standing estrus using the AM/PM rule. After breeding, gilts were penned individually indoors and restricted to their respective diets (2.23 kg/day) through to d 111 of gestation when they were placed in farrowing crates and maintained on a lactation diet until weaning. There was no difference (P > 0.10) with respect to diets on age of gilts at time of first estrus (RSB 193.2 d ± 6.86; SBM 188.4 d ± 5.97) or breeding (RSB 235.6 d ± 7.51; SBM 230.1 d ± 6.82). All but three gilts in the RSB group conceived on first AI. There was no difference in the average number of pigs born to gilts (RSB, 13.2 ± 1.29; SBM, 13.8 ± 0.59 pigs) or on the number of mummified fetuses and stillborns. Mean litter birth weights (RSB, 1.34 ± 0.08; SBM, 1.41 ± 0.05 kg) and placenta weights (RSB, 3.35 ± 0.41; SBM, 3.75 ± 0.22 kg) were not different. While there was a difference (P < 0.05) in the mean number of pigs weaned per litter (RSB, 8.90 ± .80; SBM, 11.80 ± 0.59 pigs) there were no differences in the average weaning weight of pigs (RSB, 7.90 ± 0.45; SBM, 7.50 kg ± 0.31 kg). There was an observed but not significant difference in time to return to estrus post-weaning of sows (RSB, 18.0 ± 4.59; SBM, 13.9 ± 4.79 d). These studies indicate that feeding raw soybeans as a protein dietary supplement source is not detrimental to reproductive performance in gilts.

Key Words: Raw Soybeans, Gilts, Reproduction

794 Effect of feeding Luctarom "S" 55972Z® on sow reproductive performance. D. Towey[1], J. Sonderman[2], D. Reese*[1], D. Travnicek[1], and K. Eskridge[1], [1]*University of Nebraska, Lincoln*, *Lincoln, NE*, [2]*Danbred North America*, *Columbus, NE*.

The objective of this study was to determine the effects of feeding Luctarom "S" 55972Z® (Lucta S.A., Barcelona, Spain) and maternal line on sow reproductive performance. Luctarom is a product with a milky flavor and strong cured cheese and vanilla bottom notes. Treatments were arranged as a 2 x 2 factorial with diet and maternal line as factors. Diets were corn-soybean meal based containing 1.2% total lysine, 3,260 kcal of ME/kg and 3% added fat, with or without Luctarom. Parity two to nine line 241 and 482 Danbred N.A. females (n=176) were used at a parity-segregated commercial farm. Control or Luctarom feed (containing 0.075% Luctarom) was introduced to sows when they were moved into the farrowing quarters 4d before farrowing. Sows remained on their respective dietary treatment until weaning (average 16.8 d of lactation). Prior to farrowing, sows were limit-fed, but after farrowing they were allowed ad libitum access to feed until weaning. Each sow's allotment of feed was weighed prior to dispersal. Feed disappearance was calculated the next morning by weighing any feed that remained in the feeder. All data were analyzed using analysis of covariance with parity as a covariate. In addition, day was treated as a repeated measure for the feed disappearance data. Feed disappearance before (2.36 vs. 2.52 kg/d; P = 0.222) and following farrowing (6.79 vs. 6.79 kg/d; P = 0.989) was similar for control and Luctarom fed sows, respectively. During the prefarrowing

phase, line 482 sows made more feed disappear than line 241 sows (2.67 vs. 2.19 kg/d; P = 0.010). However, during lactation feed disappearance was not different between the lines (P = 0.865). Total number of pigs born/litter (13.35 vs. 13.90; P = 0.353) and number born alive (12.21 vs. 12.66; P = 0.429) were similar for control and Luctarom fed sows, respectively. Luctarom did not improve sow feed disappearance or reproductive performance.

Key Words: Sows, Feed Intake, Flavor

795 Supplemental microbial phytase effects the expression of intestinal and liver mineral transporters in the iron/zinc deficient pig. E Tako*, R. P Glahn, R. M Welch, X Lei, and D. D Miller, *Cornell University*, *Ithaca, NY*.

Over 50% of phosphorous in beans is in the form of phytate that is poorly available. Phytases, catalyze the stepwise removal of inorganic orthophosphate from phytate. Since bioavailability of iron and zinc in foods of plant origin is a function of phytate concentration, we hypothesized that enhanced dietary phytate phosphorus utilization by supplemental microbial phytase might also produce simultaneous improvements in the bioavailabity of zinc and iron in red and white beans based diets, and by that means effect iron/zinc related transport protein gene expression in the iron/zinc deficient pig. Iron deficient piglets at age 4 wks were divided into 5 treatment groups (n=4): 1. Standard corn-soy diet (control); 2. 50% white bean diet ; 3. 50% red bean diet ; 4. 50% white bean diet + 1000 units phytase/kg diet; 5. 50% red bean diet + 1000 units phytase/kg diet. Diets 2-5 had no supplemental iron/zinc. After 30 days, animals were killed and sections of tissue from the duodenum and liver were collected for analysis of expression of iron transport genes. Semi quantitative RT-PCR used to evaluate relative expression of DMT1, Dcytb, ZnT1, mucin, ferritin and ferroportin. In the duodenum, DMT1 and Dcytb expressions were higher ($P \leq 0.05$) in the controls compared to all other groups. ZnT1 and mucin expressions were higher ($P \leq 0.05$) in groups 2, 4 compared to other groups. Ferritin and ferroportin expressions did not differ between treatments. As for the liver, ZnT1 and ferritin expressions were increased ($P \leq 0.05$) in treatment 4 compared to other treatments. These results suggest that supplemental dietary phytase may affect genes encoding for iron and zinc transporters and in this way enhance iron and zinc absorption by enterocytes. Support- HarvestPlus.

Key Words: Pig, Phytase, Gene Expression

796 Effects of dried distillers grains and NCKP soybean meal on growth performance and fat quality characteristics of growing/finishing pigs. J. M. Benz*, M. D. Tokach, S. S. Dritz, J. L. Nelssen, J. M. DeRouchey, and R. D. Goodband, *Kansas State University*, *Manhattan*.

A total of 111 barrows (maternal line PIC 1050) with an initial BW of 47.9 kg were used in an 83-d trial to study the effects of dried distillers grains (DDGS) and extruded expelled soybean meal (EESM) on growth performance and fat quality. Pigs were blocked by weight and randomly allotted to one of six treatments with two pigs per pen and nine pens per treatment. Diets were: a corn-soybean meal control diet with no added fat; corn-EESM diet with no added fat; corn-EESM diet with 15% DDGS; corn-soybean meal diet with 15% DDGS and 1.55% choice white grease (CWG): corn-soybean meal diet with 3.25% CWG; and corn-soybean meal diet with 4.7% CWG. Diets were formulated to have three dietary iodine value (IV) levels (42, 55, and 62) to compare the impact of fat source within dietary IV levels. On d 83, jowl and backfat samples were collected. Pigs fed 4.7% CWG had increased ADG compared with pigs fed either diet containing 15% DDGS. Pigs fed EESM with 15% DDGS or the diets with 3.25 or 4.7% CWG had increased G:F compared with pigs fed the control. Pigs fed either of the diets with 15% DDGS had increased backfat IV compared with pigs fed diets without DDGS. Pigs fed EESM had increased backfat IV when compared with the control diet or diets with 3.25 or 4.7% CWG. Adding DDGS to the diet or using EESM increased IV of jowl fat. Adding CWG to the control diet also increased IV of jowl fat. Feeding ingredients with higher levels of unsaturated fat, such as EESM and DDGS, had a greater impact on fat IV than CWG even when diets were formulated to similar IV levels.

Table 1.

Item	Control	EESM	EESM + DDGS	1.55% CWG + DDGS	3.25% CWG	4.7% CWG
Calculated Diet IV	42	55	62	55	55	62
ADG, kg	0.95^{ab}	0.95^{ab}	0.91^{a}	0.92^{a}	0.94^{ab}	1.00^{b}
ADFI, kg	2.88^{c}	2.74^{bc}	2.56^{a}	2.68^{ab}	2.61^{ab}	2.67^{ab}
G:F	0.33^{a}	0.35^{ab}	0.36^{b}	0.34^{ab}	0.36^{b}	0.37^{b}
BF IV	59.9^{a}	65.0^{b}	70.8^{c}	69.3^{c}	62.1^{a}	61.8^{a}
Jowl IV	64.6^{a}	68.8^{c}	72.3^{e}	70.2^{d}	66.3^{b}	67.1^{bc}
BF 18:2, %	11.2^{a}	14.5^{b}	18.4^{c}	17.3^{c}	11.8^{a}	11.9^{a}
Jowl 18:2, %	11.0^{a}	13.8^{b}	16.2^{c}	14.9^{bc}	11.6^{a}	11.9^{a}

^{abcde}Means differ (P<.05)

Key Words: Iodine Value, Dietary Fat, Pigs

797 Effects of a commercial sequestering agent on performances of fattening pigs fed diet artificially contaminated by aflatoxin B1 and ochratoxin A. G. Battacone*[1], G. A. Carboni[2], P. Nicolussi[2], C. Patta[2], and G. Pulina[1], [1]*Dipartimento di Scienze Zootecniche - University of Sassari*, *Sassari, Italy*, [2]*Istituto Zooprofilattico Sperimentale per la Sardegna*, *Sassari, Italy*.

The use of feed additives with mycotoxin adsorption capacity is a common strategy for controlling negative effects of mycotoxins in swine production systems. However, adsorbents that may results very effective under experimental conditions, i.e. when feed contamination level is rather high, do not necessarily retain their efficacy when tested under field conditions feed with generally low mycotoxin contamination. In this study the effects of diets artificially contaminated with aflatoxin B1 or ochratoxin A on fattening performance and serum chemistry of fattening pigs are investigated. Moreover, the ability of a commercial glucomannan polymer (Gm polimer) to reduce or eliminate the effects of the contaminated feeds is tested. Thirty heavy pigs (BW = 110±10.6 kg) were fed 6 diets (n = 5 pigs/diet) for 4 weeks until slaughtering. Diets were: control without toxin added (C); added with 0.02 ppm of aflatoxin B1 (AFB1); added with 0.05 ppm of ochratoxin A (OTA); other three diets as the previous but the addition of 2.0 g/kg of Gm polymer (C-Gm, AFB1-Gm, OTA-Gm). Daily weight gain (ADG) and feed efficiency ratio were taken every two weeks. Data were analyzed with two-way ANOVA that included the fixed effect of diet, time and their interaction. After the first 2 weeks the ADG did not differ significantly between the diets, even if the ADG of AFB1 diet was about 20% lower than AFB1-Gm or C. In

the last 2 weeks the ADG of AFB1 diet was significantly lover than the other diets (P<0.01) and was about one-half of the values reported for the same group in the first period. The contamination with ochratoxin A did not affect fattening performance of pigs during the whole experimental period. No damages were found in kidneys of all diets. Moreover, no evidence of association between observed liver damages and different diets. Finally, no differences between experimental diets were evidenced for the haematological parameters. The research was supported by the project *Sicurezza e qualita' nella filiera suinicola regionale* funded by the Regional Authorities

Key Words: Pig, Mycotoxins, Glucomannan polymer

798 Ghrelin secretion is more closely aligned to the energy balance than with feeding behaviour in the grower pig. P. C. Wynn*, K. Scrimgeour, M. J. Gresham, P. Thomson, and R. E Newman, *Faculty of Veterinary Science University of Sydney*, *Sydney, NSW, Australia*.

Ghrelin secreted from the gastric fundus is thought to act as an initiator of feeding behaviour in the arcuate neurocircuitary of the hypothalamus across species. Thus this hormone has the potential to stimulate feed intake and therefore animal productivity. In our study we have evaluated changes in the circulating total ghrelin activity in response to different patterns of meal feeding over a 24h period and related these to insulin and metabolite status in grower pigs. Male Large White × Landrace pigs (57.5 kg) maintained at 22oC in a 12:12 light:dark lighting regime were offered a commercial pelletted ration (13MJ DE and 6.2g Lysine per kg) ad libitum for 7 days. Blood samples were collected hourly for 24h from indwelling ear vein catheters without restraint. Animals were then offered 95% of ad libitum feed intake in 2 meals (1 hour each) at 0900 and 1600h daily for 2 days. Animals were then bled hourly for 12 hours over the 2 feeding periods. The same protocol was repeated on the subsequent day with the exception that feed was provided only at 1600h. The 12h bleeding protocol was repeated on this day. During ad libitum feeding ghrelin status (Phoenix kit) remained constant for the 24h and was not related to either insulin, glucose or free fatty acid profiles. Similarly ghrelin status did not change when animals were offered their feed as 2 meals nor as a single meal. However it was associated with a gradual rise in FFA status during meal feeding. In contrast insulin status changed in line with the increased glucose following each meal. Our results suggest that ghrelin is not an acute regulator of feeding in grower pigs.

Key Words: Ghrelin, Feeding, Pigs

Teaching/Undergraduate & Graduate Education: From Choosing a Graduate Program to Embarking on a Successful Career: A Guide for Livestock and Poultry Science Students

799 Choosing a graduate program. D. R. Notter*, *Virginia Polytechnic Institute and State University*, *Blacksburg*.

Interest in graduate education in the animal sciences is widespread among both new graduates and midcareer professionals, and graduate training opportunities in the field are becoming more diverse. Students therefore need to develop a clear understanding of their training goals and be proactive in identifying opportunities consistent with those goals. Most land-grant universities provide excellent educational opportunities for motivated undergraduates, but the choice of an individual to act as graduate advisor is critical. Consultation with faculty at the student's home institution is usually the first step in choosing a graduate program. Departments can facilitate these discussions in seminar classes and workshops. On-line resources are useful, but students should also initiate communication with prospective advisors early in the application process. Few things warm the heart of a prospective major professor more than a well-composed, grammatically correct message from a prospective student expressing enthusiasm and understanding regarding an area of study. Students should likewise expect clear signals about deadlines, funding options, and potential research areas. In most cases, if a message to a prospective advisor does not elicit a reply, look elsewhere. Recent trends in graduate education include increasing emphasis at many universities on retention of their own undergraduates and growing preferences for doctoral students. Yet we often advise students to change institutions and to complete an M.S. before embarking on the Ph.D. A critical aspect in comparing graduates program involves visiting the campus to meet prospective advisors and current students. The objective is to find out if students in the program are doing things that you aspire to do. Strong programs have students that are engaged, enthused, and mentored, with clear understanding of the expectations of their program and the relevance of their research. A campus visit provides opportunity to ask existing students about their relationship to the department and assess the extent to which they feel respected and valued.

Key Words: Advising, Graduate education, Teaching

800 Research and teaching: what else? The unwritten guide to graduate school. C. C. Taylor-Edwards*, *University of Kentucky*, *Lexington*.

What makes a successful graduate student? Graduate school is all about taking classes, teaching, and research, so these must make you successful, right? Many employers may disagree. Several of the skills that employers desire in a new hire are lacking in graduate students. Graduate students often have poor communication skills, the tendency to avoid risk, a lack of vision, and a failure to understand the value of time. However, with the awareness and willingness of the graduate student, the process of graduate school can develop a core set of competencies that can be transferred successfully to a multitude of careers. This set of skills includes time management, effective presentation communication, interpersonal relationship building, goal-setting and prioritizing, organization, and independence. These

are skills that will make an employer take notice; furthermore, they can be achieved via a variety of venues. Teaching and taking classes and conducting research certainly all lend themselves to improving these skills. However, to become an exceptional graduate student, extra effort is needed. Become involved with your department, guest lecture in classes, participate on panels about graduate school, and be involved in departmental or university-wide committees and programs. Be engaged in professional organizations; not only are they a great place to network and raise your visibility to future employers, but often offer opportunities for professional development, such as symposia, workshops, and leadership opportunities. Strive to become a well-rounded individual. In a world of increasing specialization, graduate students and faculty are often isolated in their department or discipline. This specialization isolates us socially and intellectually, and creates an environment in which it is difficult to "think outside the box". Finally, remember that with the stress and long hours of graduate school, the importance of family, friends, good health, and sleep is often underestimated. Keeping these a priority can improve productivity in the classroom or lab and lead to the formation of a highly successful graduate student, valued by future employers.

801 Opportunities outside of the lab, international experience, networking, and professional societies? J. S. Radcliffe*, *Purdue University*, *West Lafayette, IN*.

Obtaining a graduate degree in Animal Sciences requires a significant amount of laboratory, animal, and course work. However, often opportunities outside of these traditional settings may be most beneficial to the student and to the advisor's research program. Individuals seeking a laboratory to complete a graduate degree in are often instructed not to get all of their degrees from one institution. The rationale behind such advice is that it is good to gain different experiences and perspectives by attending more than one University. While this advice seems reasonable, it still usually limits the student's exposure to labs conducting similar research within the United States. As the globalization of agriculture continues, it is becoming increasingly important for individuals in Animal Sciences to have a global rather than a national perspective of agriculture. International opportunities for graduate students during their degree program are invaluable in helping students to obtain a broader perspective of agriculture and how their research may impact animal agriculture. Providing graduate students with an international opportunity can be as simple as letting them attend an international meeting or as complex as allowing them to complete a portion of their research in a lab based outside of the United States. The advantages and disadvantageous of such opportunities will be discussed based on personal experience as a student and advisor.

Key Words: Graduate Education, International Experience

Bio Ethics - Livestock and Poultry

802 Why it is important to understand bioethical concepts. R. D. Reynnells*[1], C. C. Croney[2], and D. J. R. Cherney[3], [1]*USDA/CSREES/PAS, Washington, DC*, [2]*Oregon State University*, *Corvallis*, [3]*Cornell University*, *Ithaca, NY*.

Understanding bioethics helps us discern how food animals ought to be treated, and is basic to our views of animal welfare and animal rights. Few of us were trained in philosophy or ethics. Our ethical training primarily is based on religious concepts or societal expectations. Bioethics, ethics applied to biological systems, increasingly influences decisions by stakeholders and officials. Philosophical attacks on food animal production may first eliminate Judeo-Christian religious concepts, and then dissect secular ethics based on rules of logic. Change is promoted based on these chains of logic that discard current norms for animal use in favor of new found "truths". Organizations are changed by decision makers' understanding of issues, structural requirements and goals, desires, political pressure, etc. Agricultural firms are no different. Decision makers may include consumers who make purchasing decisions (drive market demand), voters, government officials, and producers. Historically, cheap food demand has been a major change agent for agriculture, as has the desire of farmers to avoid undesirable situations. It is increasingly difficult, and yet imperative, to balance ethical considerations with economic and practical aspects of animal agriculture. This balance is complicated if production changes are not market driven but imposed by persons apparently attempting de facto management, absent the risks, of farmer's resources. New standards for change are not restricted to questions about how to efficiently raise food animals, but include concepts of refinement, reduction, and replacement of animal management and care practices. Consideration of whether or not we should use animals for food is a crucial ethical concept. Several bioethical concepts will be discussed. Should bioethical and animal welfare science considerations be the basis of our management and regulatory decisions? Should a person's or organization's vision of ethical behavior be forced on an industry and society, or should changes in agriculture come through true market demand? Also to be discussed is how our awareness of bioethical concepts facilitates our ability to properly address animal welfare issues.

Key Words: Animal Welfare, Bioethics, Societal Expectations

803 The ethical landscape of non surgical embryo-transfer in pigs: An explorative study of public concerns. F. R. Stafleu[2], D. W. B. Ducro-Steverink[1], and J. W. M. Merks*[1], [1]*IPG, Institute for Pig Genetics B.V.*, *Beuningen, the Netherlands*, [2]*Ethics Institute, Utrecht University*, *Utrecht, the Netherlands*.

Non surgical embryo transfer (nsET) focuses on the development of a technique in pig production to improve genetic preservation and international trade. In modern society however, the public is concerned about ethical aspects of animal production. To get an impression of these "public concerns", an opinion about the nsET technique was asked of four groups: agricultural professionals involved in nsET, professionals of the Eurogroup for Animal Welfare, volunteers of the Dutch Society for the Protection of Animals and a group of members of the public. An ethical analytical tool (the ethical Matrix) was used to collect these opinions in a standardized way. Rooted in these opinions, an ethical analysis of moral problems possibly connected

with the technique was made, resulting in a description of the "ethical landscape" of the technique. From the results it emerges that, seen from inside the practice of pig breeding, it is a skillful technique with clear economic and animal welfare advantages. But many of the contra arguments come from an outside perspective and are concerned mostly with the "unnaturalness" of the procedure and the negative impact that the technique may have on biodiversity. Also the technique is often associated with intensive farming which has for many a negative connotation. It is concluded that moral criticism is possible. Whether this criticism leads to an overall negative moral judgment remains to be seen; an overall judgment falls outside the scope of this study. It is stressed that in a pluralistic democratic society it is very important that agricultural professionals discuss these issues with the rest of society, each on the basis of their own ethical convictions. In such a discussion the strong and the weak points will emerge and a judgment can be made.

Key Words: Ethics, Non Surgical Embryo Transfer, Pigs

804 Animal welfare and the ethics of care: Towards a sustainable practice. R. Anthony*, *University of Alaska*, *Anchorage*.

Recently, the ethics of care has become part of the vocabulary in animal welfare ethics. It has gained momentum in animal welfare circles because the orientation that it takes best suits the apparent progress we've made in understanding animals' capabilities and how they are harmed, and because of its genuine desire to converge toward appropriate and sustainable ethical norms by appreciating the set of cultural and technological practices involved in farming. The ethics of care approach, in contrast with formal rule theories like utilitarian and rights-based approaches, begins not with the "what, if anything, do we owe animals" question, but instead with the context sensitive question of "how can we better meet our care responsibilities, to those who rely on us". After a brief consideration of the moral, political and technological contexts of agriculture, I attempt to show what it might take for an ethics of care to occupy a central role in our animal farming practices. Following scholars in this area, four key elements of an ethic of care will be delineated (i.e., attentiveness, responsibility, competence, and responsiveness) and applied to farmed animal welfare ethics.

Key Words: Animal Ethics, Animal Well-Being, Ethics of Care

805 Animal biotechnology: where to from here? A. L. Van Eenennaam*, *University of California*, *Davis*.

Biotechnology is defined as the application of science and engineering to living organisms. From this definition it is obvious that livestock breeders have been practicing animal biotechnology for many years. However, in recent years this term has been increasing associated with the technologies of cloning and genetic engineering. Products of these controversial technologies are slowly starting to move towards commercialization with the first human therapeutic compound derived from the milk of a genetically engineered animal being approved by the European Commission in 2006. The global market for recombinant proteins from domestic animals is predicted to reach US$18.6 billion in 2013. Similarly, the entry of products from cloned animals into the food supply also moved a step forward with the release of the FDA's draft risk assessment which found that edible products derived from marketable clones posed no additional food consumption risks relative to corresponding products from sexually-derived animals. However, the animal biotechnology industry still faces a variety of scientific, regulatory, ethical, and public acceptance issues. Many polls have concluded that the majority of people are opposed to 'animal biotechnology'. Closer examination reveals opinions are technology-dependent, with most people being favorably disposed towards the concept of genomics, and less supportive of genetic engineering and cloning. The industry is also faced with uncertainty arising from whether governmental agencies intend to consider moral and ethical factors, in addition to scientific evaluation of risks and benefits, when making regulatory decisions about cloned or genetically modified animals. Perhaps in response to public opposition or decreased funding support, the previously increasing numbers of published papers on cloning and genetic engineering have leveled off in recent years. Additionally, relatively few scientists have actively participated in the public discourse by articulating the science-based risks and benefits, in addition to the ethical issues, occasioned by these potentially-compelling technologies. It is currently unclear what role publicly-funded animal scientists will play in arriving at a societal consensus on the acceptable uses of animal biotechnology.

Key Words: Biotechnology, Cloning, Genetic Engineering

ADSA Production Division Symposium

806 Feeding programs that meet the challenges of heat stress. J. N. Spain* and D.E. Spiers, *University of Missouri*, *Columbia*.

Increased levels of milk production has increased the metabolic heat load lactating dairy cows must transfer to the environment to maintain thermal balance. As a result of this advanced genetic base, the incidence and severity of heat stress has increased. Heat stressed dairy cattle experience significant adverse responses including decreased milk production, increased incidence of mastitis, decreased fertility and lower reproductive success. Management strategies focus on reducing the thermal stress by decreasing heat load while concurrently increasing heat loss. Nutritional management strategies have been developed to support heat stressed dairy cows. Increased nutrient density and diets with a lower heat increment have been designed to decrease the heat load. Heat stressed cows have increased nutrient demands associated with higher requirement of electrolytes. Heat stress also alters rumen function. Decreased rumination, lower saliva secretion and lower buffering capacity of saliva increase the incidence of ruminal acidosis. Use of feed additives to help maintain a higher ruminal pH can provide important therapeutic support of the heat stressed cows. In addition, the lower rate of passage also decreases microbial efficiency and flow of microbial protein from the forestomachs. Therefore, the adjustment of protein supplementation can be made to maintain optimal amino acid flow to the small intestine. Therefore, seasonal adjustments of nutritional management strategies can be implemented to help mitigate the negative impact of elevated temperature and humidity on high producing dairy cattle.

Key Words: Dairy, Heat Stress, Nutrition

807 Environmental modifications to address heat stress. M. J. Brouk*[1], J. P. Harner, III[1], J. F. Smith[1], and D. V. Armstrong[2], [1]*Kansas State University*, *Manhattan*, [2]*University of Arizona*, *Tucson*.

Heat stress results in significant economic and production losses for dairy operations throughout the world each summer. Due to the continuous nature of dairy production, losses in the current lactation often result in losses in subsequent lactations or premature culling of animals. Reduction of losses due to heat stress represent an opportunity for dairy producers to gain a competitive edge. As a result, many producers have utilized different methods of heat abatement. In general these methods can be divided into two groups, those which enhance heat exchange between the cow and the environment or those which modify the environment to prevent or limit the degree of heat stress to which the animals are exposed. Increased heat exchange generally involves increasing heat loss from the body surface by enhancing heat loss mechanisms. The most common methods involve the addition of water to the hair coat and supplemental airflow to increase the rate of evaporation of the additional water and sweat enhancing heat exchange which reduces body temperature. Heat stress abatement with these systems is generally achieved by cooling heat stressed cattle. Environmental modifications attempt to reduce the potential for heat stress by lowering the temperature of the air around the cow. Evaporation of water into warm air reduces the temperature while increasing the relative humidity. Water evaporation can be achieved by high pressure fogging systems or by drawing warm air through evaporative pads. The challenge is to maintain an environment in which the temperature-humidity index is below the heat stress threshold for lactating dairy cattle. Critical factors for consideration when evaluating these systems is the air temperature and relative humidity of the environment. An inadequate or improperly designed system may actually increase the THI above the unmodified environment. When selecting a heat abatement system, one should consider production goals, facilities, environment, heat stress potential, water supply, and economic factors. In some very stressful environments, application of both environmental modifications and surface heat exchange may be beneficial.

Key Words: Cooling, Facilities, Environmental Stress

808 What we have learned about the genes involved in the response to heat stress. R. J. Collier* and R. P. Rhoads, *University of Arizona*.

Climate has profound effects on animal performance (i.e. growth, reproduction and lactation) and understanding the interaction between thermal environment and animal production has been the subject of intense research. Traditionally, examination of heat stress effects have focused on physiological and phenotypic changes, however, the development of molecular tools is allowing animal scientists to characterize transcriptional alterations across the genome and identify key cellular responses to heat stress. Gene expression changes associated with thermal environment may be grouped into 3 categories; acute, acclimatory and adaptive. Acute and acclimatory responses occur on a physiological and cellular level and decay with removal of the stress while adaptive responses involve short and long-term genetic alterations. At the systemic level, gene families associated with homeorhetic regulation of metabolism (growth hormone, prolactin, thyroxine, glucocorticoids) play an important role in heat stress acclimation. At the cellular level, thermal tolerance is maintained as long as heat shock family proteins are elevated and lost when expression of these genes declines in the face of continued stress. Cellular expression of heat shock proteins during thermal stress is altered by prolactin, IGF-I and prostaglandins E2 and A1. indicating that considerable opportunity may exist to improve thermotolerance. Evolutionary adaptation to heat stress involves genotypic differences associated with coat color, hair quality and density and sweat gland function which are related to inter-breed variation in heat gain and loss. Short-term genetic alterations involving epigenetic regulation of gene expression and thermal imprinting of the genome represent potentially promising but relatively unexplored areas in animal agriculture. Opportunities exist to improve thermal tolerance of animals by selection for specific hair coat characteristics, homeorhetic responses to thermal stress and improved heat shock response. The heat shock response opportunity is greatest during early embryonic development.

Key Words: Heat Stress, Gene Expression, Acclimation

Breeding and Genetics - Livestock and Poultry: Swine

809 Genetic factors affecting growth traits of Nili-Ravi Buffalo calves in Pakistan. P. Akhtar*, U. Kalsoom, S. Ali, M. Yaqoob, M. I. Mustafa, and J. I. Sultan, *Faculty of Animal Husbandry, University of Agriculture*, *Faisalabad, Punjan, Pakistan*.

Records on body weights at different ages of 624 Nili Ravi buffalo calves (from 1989 to 2002) kept at LES, Bahadurnagar, (Pakistan), were analyzed by computer programs LSMLMW and DFREML. Average weights at birth , weaning and yearling were 35.86±4.30, 66.12±9.16 and 145.82±19.50 kg. Pre-weaning average daily gain was 316 ± 88 gm, while post-weaning average daily gain was 301±29 gm. The ANOVA indicated that year and season of birth, age and weight of dam significantly effected the traits. Maximum weights were observed in spring season, while minimum gains were obtained in other seasons. Maximum heritability was 0.25±0.14 for birth weight, while minimum heritability was observed for weight at nine months of age that was 0.11±0.12 which indicates that growth traits were moderate to highly heritable suggesting that selection will be a best criteria for improvement. Among phenotypic correlations maximum correlation was 0.90 that was between weaning weight and weight at six months of age whereas minimum correlation was observed in birth weight. Environmental, phenotypic and genetic correlations were fairly large and positive indicating that selection for the improvement of one trait will positively affect the other trait.

Key Words: Genetic Factors, Growth, Buffalo Calves

810 Genetic analysis of ewe stayability and its association with lamb growth and adult body weight. R. C. Borg[1], D. R. Notter*[1], and R. W. Kott[2], [1]*Virginia Polytechnic Institute and State University*, *Blacksburg*, [2]*Montana State University*, *Bozeman*.

Records from 2,525 adult Targhee ewes and 10,099 lambs were used to estimate genetic parameters in an animal model for ewe stayability (STAY), weaning weight (WW), adult weight (AW), and number of lamb born (NB). Weaning weights were recorded at approximately 120

d of age. Annual NB and AW were recorded at lambing and weaning, respectively. Stayability were analyzed as overall stayability (STAYn|2) which indicated presence or absence of a ewe at n yr of age, given the ewe was present at 2 yr of age, or marginal stayability (STAYn|n-1) recording the presences of a ewe at n yr of age, given the ewe was present in the previous year. Adjustments were made to WW for effects of age, type of birth and rearing, age of dam, and sex, and NB was adjusted for ewe age effects. Birth year was included as a fixed effect on all traits; additional fixed effects of management group on WW and ewe age and type of birth and rearing on AW were also included. Models for all traits included random direct additive genetic and residual effects. Uncorrelated random effects of the ewe were also included for AW and NB, and additive maternal and dam permanent environmental effects were included for WW. Additive variance in STAY was only present after 5 yr of age ($P < 0.05$), so only STAY5|4 and STAY6|2, with heritability estimates of 0.08 and 0.10, respectively, were used in multiple-trait analyses. All phenotypic correlations involving STAY were near zero, ranging from -0.04 to 0.03. Estimates of direct additive-maternal correlations of STAY5|4 and STAY6|2 with WW were positive (both 0.46; $P < 0.05$), suggesting that STAY and maternal effects on WW may both reflect genetic variation in ewe fitness characteristics. Genetic correlations between STAY6|2 and WW, AW, and NB were all negative, with values of -0.17, -0.32 ($P < 0.05$) and -0.03, respectively, indicating a possible small antagonism between STAY and additive effects on body size.

Key Words: Sheep, Heritability, Stayability

811 Gene regulation in liver of cattle exposed to heat stress. E. Antoniou*, J. Robertson, and D. Spiers, *University of Missouri*, *Columbia*.

Summer heat stress results annually in hundreds of million of dollars of lost productivity and impaired animal health. Cattle have reduced feed intake, lower growth and conception rates, panting activity, increased peripheral blood flow and sweating. Although these effects are well documented, the changes in cellular function and gene regulation are poorly understood. Liver is one of the major organs involved in the regulation of metabolism and heat production. The goal of this study is to investigate the changes in gene regulation in liver of cattle under long term mild heat stress. Angus steers (n=5) from the University of Missouri herd were housed in the Brody Environmental Center. Steers were maintained for 7 days at a temperature of 19.07 ± 0.06°C after which liver biopsies were obtained. Heat stress consisted of a 14 day exposure to a cycle of 27.39 ± 0.15°C nighttime low to 36.21 ± 0.14°C daytime high temperatures. Biopsies were again performed at the end of the heat stress period. RNA was extracted, labeled and hybridized to our cDNA bovine cDNA array. The microarrays were printed using PCR products amplified from 17,692 bovine cDNA clones. Normalization was accomplished by using a two-stage ANOVA analysis and a list of differentially expressed genes was obtained using the Fs statistic. A total of 100 differentially expressed genes were identified with at least a 40% up- or down-regulation and a false discovery rate of less than 0.05% (adjusted for multiple testing using permutations). Some genes involved in oxidative stress were down-regulated, such as Metallothionein 1, 2, and 3 (80%) and glutathione peroxidase (40%), while glutathione S-transferase was up-regulated by heat stress (240%). Insulin-like growth factor binding proteins 2 and 5 were up-regulated 200% and 160 %, respectively. Heat shock 70-kD protein 2 was up-regulated by 160%. Several genes involved in energy metabolism were differentially expressed, such as cytochrome c oxidase subunit I and III, ATP synthase F0 subunit 8, and NADH dehydrogenase subunit 4L and 5. A number of genes involved in immune functions were also differentially expressed under heat stress.

Key Words: Heat Stress, Microarray, Liver

812 Differential gene expression profiling of malignant melanoma in Sinclair swine. M. A. Okomo-Adhiambo[1], A. Rink[2], W. Rauw[1], C. W. Beattie[3], and L. Gomez-Raya*[1], [1]*University of Nevada*, *Reno*, [2]*Animal Disease and Food Safety Laboratory*, *Reno, NV*, [3]*University of Illinois*, *Chicago*.

The miniature strain of Sinclair swine develops an aggressive form of malignant melanoma, which in many cases spontaneously regresses after a complete metastatic phase. We used Affymetrix GeneChip® Porcine Genome Array consisting of 24,123 transcripts to compare gene expression profiles of blood and visceral tissues harvested from a Sinclair piglet afflicted by melanoma at birth and exhibiting metastatic lesions at weaning (6 weeks), with those from a full sibling piglet that showed no incidence of melanoma at birth and at weaning. Between 2% (in spleen) to 14% (in liver) of analyzed transcripts were significantly up-regulated (fold change in gene expression ≥ 2.0 and t-test p-values ≤ 0.05) in tissues sampled from the melanoma pig compared to those sampled from the normal pig, while 3% (in blood) to 15% (in inguinal lymph node) were significantly down-regulated. Among the modulated transcripts were genes directly involved in melanoma development and progression, as well as genes generally associated with cancer pathogenesis including oncogenes, transcription factors, cell cycle regulators and apoptosis related genes. These results suggest that significant changes in gene expression occur during the progression and metastasis of malignant melanoma in the Sinclair pig model, facilitating further analysis for discovery of candidate genes and transcriptional pathways that can be utilized in the development of novel intervention and diagnostic strategies for malignant melanoma.

Key Words: Malignant Melanoma, Sinclair Swine, Oligonucleotide Microarrays

813 Genetic parameter estimates for growth, carcass composition, and meat quality traits in Duroc swine. C. R. Schwab*, R. Tait, and T. J. Baas, *Iowa State University*, *Ames*.

The objective of this study was to estimate genetic parameters for growth, carcass composition, and meat quality traits in Duroc swine. Five generations of data from a project involving selection for increased intramuscular fat (IMF) using real-time ultrasound were analyzed. Within each generation, off-test ultrasonic measures (n = 3885) were collected on all three genders. Loin samples from all available barrows and randomly selected gilts (n = 847) were collected at a commercial abattoir for carcass composition and further meat quality assessment. Genetic parameters were estimated using MTDFREML procedures applied to a two-trait animal model that included fixed effects of sex and contemporary group along with a random effect for permanent environment of the litter. A covariate of BW was included for traits measured at off-test, and a covariate of carcass weight was included for composition traits measured on the carcass. Average heritability values across all two-trait analyses for IMF and ultrasonically predicted

intramuscular fat (PFAT) were 0.56 and 0.30, respectively, and their mutual genetic correlation was 0.87. The table shows estimated heritabilities and genetic correlations of IMF and PFAT with selected growth, carcass composition, and meat quality traits. The estimated genetic parameters further validate the use of ultrasound measurements in breeding programs aimed at meat quality improvement.

Table 1. Heritability and genetic correlation estimates of growth, carcass composition, and meat quality traits in Duroc swine

Trait	h^2	Genetic Correlation IMF	PFAT
Weight per day of age	0.32	-0.08	0.18
Ultrasonic 10th rib backfat	0.57	0.46	0.52
Ultrasonic loin muscle area	0.55	-0.25	-0.30
Carcass 10th rib backfat	0.41	0.52	0.42
Carcass loin muscle area	0.59	-0.71	-0.45
24 hr pH	0.32	-0.04	-0.05
24 hr Minolta reflectance	0.26	0.72	0.54
Percent cooking loss	0.06	0.01	0.08
Instron tenderness	0.16	-0.30	-0.10

Key Words: Genetic Parameters, Heritability, Swine

814 Doe reproductive and fitness traits among three meat goat breeds semi-intensively managed in the southeastern US. R. Browning, Jr.*, M. L. Leite-Browning, B. Donnelly, and M. Byars, *Tennessee State University*, *Nashville*.

In the fall of 2003-2005, Boer (BR; n = 81), Kiko (KK; n = 64), and Spanish (SP; n = 59) straightbred does were exposed to Boer, Kiko, and Spanish bucks in a complete 3-breed diallel mating scheme to assess doe reproductive performance on southeastern US pastures. Does were managed together in a semi-intensive manner. This 3-yr dataset represents 157 BR, 152 KK, and 150 SP doe exposures. The proportion of exposed does delivering at least one live kid was lower ($P < 0.01$) for BR (82%) than for SP (93%) and KK (96 ± 3%). Litter size (1.9 kids) and litter weight (6.03 kg) at birth were not affected by breed of dam. By weaning at 3 mo, the proportion of exposed does weaning at least one kid was lower ($P < 0.01$) for BR (72%) than for KK and SP does (88 ± 4% each). Litter size at weaning was smaller ($P < 0.01$) for BR (1.55 kids) than for SP dams (1.8 ± 0.06 kids); KK were intermediate with 1.65 kids. Litter weight at weaning was lightest ($P < 0.01$) for BR (25.7 kg) than for KK dams (29.5 ± 1 kg); SP dams were intermediate (28.2 kg). The efficiency ratio of litter weight to dam weight at weaning was greater ($P < 0.01$) for SP and KK (67 and 61 ± 2%, respectively) compared to BR dams (52 ± 2%), SP and KK tended to differ ($P = 0.1$). As measures of whole herd performance based on all does exposed to bucks, BR does weaned a lower ($P < 0.01$) kid crop percent and litter weight (112%, 18.5 kg) compared to KK (144%, 25.8 kg) and SP (157 ± 9%, 24.5 ± 1.5 kg). Annual doe treatment rates for lameness and internal parasitism and attrition rates were higher ($P < 0.01$) for BR (71, 50, and 21%) than for SP (39, 24, and 8%) and KK does (31 ± 5%, 17 ± 5%, and 7 ± 4%). Fecal parasite egg counts differed ($P < 0.01$) among each of the three dam breeds: BR = 523, KK = 331, and SP = 233 ± 45 eggs/g. Results at this point of the study indicate that significant differences exist among meat goat breeds for doe performance on southeastern pastures.

Key Words: Meat Goat, Breed, Reproduction

815 Measures of libido and their relation to testicular hypertrophy and fertilizing competence in boars. D. O. Umesiobi*, *Central University of Technology*, *Bloemfontein, Free State, South Africa*.

The aim of this study was to determine whether the testicular hypertrophy and reproductive competence in boars could be evaluated by selected measures of libido. Twenty-four (12 months old) Large White boars were randomly selected using standard tests for libido: reaction time (RT). Eight boars were assigned to each of the three treatment combinations involving 0, 5 and 10 minutes of sexual restraint (R). Semen was collected using gloved hand device following sexual stimulation and analyzed for quantitative and qualitative parameter using standard methodology. Sperm cells from each boar were used to artificially inseminate (AI) 10 oestrus-synchronized gilts (twice), 12 and 24 hours after the onset of oestrus. Boars were hemi-orchidectomised after 16 weeks of the experimental period. Sexual excitement of boars at 5 and 10R caused the weight of the testis to hypertrophise by 220.2% and 501.6%, respectively, as compared to the unexcited control (38.5%) boars. Total daily sperm production per testis (TDSP) increased to 160.3% and 328%, respectively, with this increase being dramatic (328%) in the 10R boars. Sexual excitement of boars at 10R resulted in the highest testicular traits, number of mounts (10.4 ± 1.6 per 30 min), ejaculation rates (4.1 ± 0.9 per 30 min, total sperm count (92.1 ± 3.1x10^9), sperm motility (89.7 ± 1.4%) and normal acrosome morphology (94.4 ± 2.6%), with the shortest RT (1.5 ± 0.5 min). Gilts artificially inseminated with sperm cells from 10R boars exhibited significant improvements than the 5R boars, in NRR (91.5 ± 6.7 vs. 50.8 ± 13.3%), farrowing rate (88.3 ± 5.5 vs. 53.1 ± 9.2%), total piglets born (12.0 ± 0.4 vs. 5.5 ± 0.8) and live piglets (11.4 ± 0.2 vs. 3.5 ± 0.6). Results suggest that sexual excitement of boars induces testicular hypertrophy, leading to significant improvement in the fertilizing competence of boars.

Key Words: Boar Sexual Drive, Testicular Traits, Sow Fertility

816 Comparison of pure Berkshire, Landrace, and the reciprocal crosses at two market endpoints. K. M. Brueggemeier*, A. C. Naber, S. J. Moeller, H. N. Zerby, and K. M. Irvin, *The Ohio State University*, *Columbus*.

The objective of the study was to assess differences of two divergent breeds, using pure Berkshire (BB), Landrace (LL) and their reciprocal crosses (BL and LB; sire represented as the first letter) for carcass and pork quality traits at two market endpoints. The study was conducted in two seasons (n = 74 and 79) with approximately equal representation of the four combinations in each season. Pigs of each combination were harvested at two end-points: harvest 1 (H1; average weight 105 kg, 151 d) and harvest 2 (H2; average weight 123 kg, 178 d). Tenth rib backfat (BF), loin muscle area (LMA), Minolta L* (L), visual marbling score (MARB), and pH were assessed at 24 h postmortem with Warner-Bratzler Shear force assessed after aging for 7 d. Data were analyzed using a mixed model within a harvest endpoint. Fixed effects were breed combination, sex, and breed x sex interaction, with a random sire within breed combination effect, and live weight was included as a linear covariate for carcass traits. The only differences observed for BF occurred in H1 with BB pigs being significantly fatter ($P < 0.01$) than LL. For LMA in H1 and H2, BB pigs had less LMA than LL ($P < 0.05$) and LB pigs ($P < 0.07$); however, LB and LL pigs did not differ. Differences ($P < 0.01$) in pH were observed across breed combinations in both H1 and H2 and BB pigs had greater

(P < 0.05) pH when compared with all other combinations. For L within H1 and H2, loins from LL pigs were paler (P < 0.05) than all other combinations. In addition, loins from BB pigs had greater MARB at H1 and H2, with no differences among other combinations. Shear force followed a similar trend, with loins from BB pigs requiring less (P < 0.05) force than those from BL at H1 and les force than those of LL at both H1 and H2. The data suggest that F1 crosses of Berkshire and Landrace were not different in carcass composition, but were poorer in pork quality attributes than pure Berkshire contemporaries and for many quality attributes the LL pig produced inferior quality.

Key Words: Swine, Pork Quality, Carcass

817 Correlated response in fatty acid composition from five generations of selection for intramuscular fat in Duroc pigs. J. L. Burkett*, T. J. Baas, D. C. Beitz, C. R. Schwab, N. L. Berry, and S. Zhang, *Iowa State University*, *Ames*.

The objective of this study was to evaluate differences in fatty acid composition differences among Duroc pigs selected for increased intramuscular fat (IMF) for five generations. Selection was based on EBV for IMF estimated by fitting a two-trait animal model and the full relationship matrix in MATVEC. In the select line (SL), the top 10 boars and top 50% of gilts were used to produce the next generation. One boar from each sire family and 50 gilts representing all sire families were selected randomly to maintain the control (CL). Longissimus muscle samples (n=175, 136 barrows, and 39 gilts) collected from generation 5 pigs in the CL (n=102) and SL (n=73) were used to determine the fatty acid profiles of IMF. Total lipids were extracted from the trimmed longissimus samples and methylated directly with acetyl chloride and methanol. Methyl esters were quantified by using a gas chromatograph with a 100 m column and flame ionization detector. Data were analyzed using a fixed linear model containing main effects of line and gender, and covariates of carcass contemporary group and total lipid within line. Select line pigs had more (P < 0.01) total lipid (5.15% vs. 3.07%) than did control line pigs. There were no differences (P > 0.05) in SFA, MUFA, MUFA:SFA, and atherogenic index (AI) between CL and SL pigs. A significant decrease (P < 0.01), however, was detected in total essential fatty acid composition (18:2+18:3n3) and PUFA:SFA in the SL when compared to CL pigs. This difference could be the result of greater de novo synthesis of fatty acids in the SL resulting in a dilution effect of the essential fatty acids as based on more total lipid. These results suggest that selection for increased intramuscular fat could lead to improved meat quality without affecting nutritional value.

Key Words: Fatty Acid Composition, Intramuscular Fat, Pigs

818 Analysis of incidence of Porcine Circovirus Associated Disease (PCVAD) in a landrace/large white composite population. J. S. Bates*, A. R. Doster, and R. K. Johnson, *University of Nebraska*, *Lincoln*.

The objective was to determine the importance of genetic and environmental effects on the incidence of Porcine Circovirus Associated Disease (PCVAD) in pigs. 1,905 pigs from Generations 24 and 25 of two lines selected for increased reproduction and growth and two control lines were scored for symptoms of PCVAD. From 60 d of age pigs were grown in confined buildings or outside lots containing straw-bedded hoop structures. Scoring was on a scale of 0 (no symptoms), 1 (suspect), or 2 (positive) for symptoms including muscle wasting, growth retardation, rough hair coat, diarrhea, and skin lesions, and was done weekly from 70 to 180 d of age. 16.3% of the pigs received a score of 2. A sample of 37 pigs with a score of 2 were necropsied and lung, lymph node, tonsil, liver, kidney, thymus, spleen, ileum, and colon tissue was microscopically examined for lesions suggestive of PCVAD. Immunohistochemistry and RT-PCR were used to detect the presence of PCV-2 in collected tissues. All 37 pigs scored as a 2 were positive for PCV-2. PCVAD score was analyzed with ASREML using the Binomial and Probit functions to estimate genetic and environmental effects. Pigs receiving at least one score of 2 were considered positive for PCVAD; all pigs scored with a 0 or 1 were considered negative. Direct and maternal birth dam heritabilities were 0.02 ± 0.001 and 0.12 ± 0.006, respectively. The proportion of variance due to common birth litter and common nurse litter effects were 0.13 ± 0.04 and 0.01 ± 0.001, respectively. The proportion of variance due to pen effects was 0.05 ± 0.03. Differences between select and control lines were not significant. Significant differences (P<0.05) in weight between negative and positive pigs, estimated in MTDFREML, were 0.09 kg at birth, 0.57 kg at weaning, 4.77 kg at 70 d, and 23.74 kg at 180 d. Probability of score 2 was greatest in pigs placed outside and least for pigs in temperature-regulated buildings (P<0.01). Maternal genetic, common birth litter, and environmental variation affect incidence of PCVAD.

Key Words: Genetic Variation, PCVAD, Immunity

819 Breeding for robust pigs across the year in heat stress affected areas. B. Zumbach[1], I. Misztal[1], S. Tsuruta[1], J. P. Sanchez*[1], M. J. Azain[1], W. Herring[2], J. Holl[2], and T. Long[2], [1]*University of Georgia*, *Athens*, [2]*Smithfield Premium Genetics Group*, *Rose Hill, NC*.

The aim of this study was to describe genetic variability of pig carcass weight as a function of heat stress. Data included carcass weights of 21,653 crossbred pigs (Duroc x [Landrace x Large White]) raised on two farms in North Carolina, and harvested from May 2005 through September 2006. Weather data were obtained from a nearby weather station. Monthly heat loads were calculated as degrees of average temperature-humidity index (THI) in °C over 23. Assumed heat load (H) was a sum of heat loads 4 months prior to harvest. The H was the greatest for pigs harvested in August-October 2005 (4.3-4.5) and 2006 (3.3), respectively, intermediate in July and November, lowest in June 2005, and none for the remaining months. Variance components were estimated with 3 models: univariate - not accounting for heat stress, 2-trait and random regression using linear splines (RRMS). Effects included in all the models were contemporary group, sex, and age at slaughter, sire, and litter. The 2-trait model treated observations July/August-October ("hot") and December-June ("cold") as separate traits. RRMS added a random regression on heat load for the sire effect with 3 knots at H=0, 2.2, and 4.5, respectively. The heritability estimate ± SE in the univariate model was 0.17±0.01. In the 2-trait model the estimates were 0.15±0.01 for "cold" and 0.34 for "hot"; the genetic correlation (0.08±0.15) was not significant. The heritability estimates with RRMS were 0.15±0.08, 0.27±0.11, and 0.59±0.16 for H=0, 2.2, and 4.5, respectively. The genetic correlations between H=0/H=4.5, H=0/H=2.2, and H=2.2/H=4.5 were -0.45±0.14, 0.30±0.16, and 0.50±0.13, respectively. This study supports the existence of genotype by environment interaction in growth traits of pigs across commercial environments.

Key Words: Pig, Carcass Weight, Heat Stress

820 Addition of probiotic microorganisms to improve proteolysis, sensory evaluation and the release of antihypertensive peptides in Cheddar cheeses ripened at 4 and 8ºC. L. Ong[1], N. P. Shah*[1], and A. Henriksson[2], [1]*Victoria University*, *Werribee, Victoria, Australia*, [2]*DSM Food Specialties*, *Moorebank, NSW, Australia*.

Our objectives were to assess the influence of probiotic microorganisms and ripening conditions on proteolysis, organic acid production and sensory evaluation of Cheddar cheeses, and to examine the release of angiotensin-converting enzyme (ACE)-inhibitory peptides during ripening. Cheddar cheeses were made using starter culture and probiotic microorganisms and ripened at 4 and 8°C for 24 wk. Proteolytic patterns were examined using SDS-PAGE and by monitoring water soluble nitrogen, PTA-soluble nitrogen and TCA soluble nitrogen. Organic acids were analysed using HPLC. Semi-trained panellists (n=15) were used in sensory evaluation. ACE-inhibitory activity was measured using spectrophotometric method. Peptides were purified using RP-HPLC and identified using MALDI-TOF. Addition of probiotic organisms and higher ripening temperature increased proteolysis and the concentration of lactic, acetic and propionic acids in Cheddar cheeses ($P< 0.05$). Acceptability of probiotic cheeses during sensory evaluation was not affected by the increased proteolysis and organic acids concentration. The ACE-inhibition of the cheeses stored at 8°C was not significantly different to those stored at 4°C. The ACE-inhibitory activity of the probiotic cheeses (IC_{50}, 0.15-0.20 mg/mL) was higher compared to the cheeses without probiotic (IC_{50}, 0.22 mg/mL) after 24 wk of ripening. The lowest value of the IC_{50} (0.15 mg/mL), and therefore the highest ACE-inhibitory activity, corresponded to cheeses made with the addition of *Lb. acidophilus* LAFTI® L10 ripened at 8°C. Various ACE-inhibitory peptides from the water-soluble extract of the cheeses corresponding to α_{s1} -casein [(f1-6), (f1-7), (f1-9), (f24-32) and (f102-110)], and β-casein [(f 47-52) and (f193-209)] were identified. Probiotic organisms used in this study can be added successfully in Cheddar cheeses for their health benefits while simultaneously producing bioactive peptides for further health attributes.

Key Words: Probiotic, Cheese, Angiotensin Converting Enzyme

821 Ras cheesemaking using starter cultures and nonstarter lactic acid bacteria isolated from the Pharos land. M. El Soda*, S. Awad, and N. Ahmed, *Faculty of Agriculture, University of Alexandria*, *Alexandria, Egypt*.

Consumers make their choice of cheeses primarily based on flavor characteristics. Cheese flavor results mainly from the biochemical activities of the starter and nonstarter lactic acid bacteria. Ras cheese is the main hard cheese made in Egypt; it is also appreciate in many neighbor countries. The cheese has been manufactured for a long time from raw milk. Nowadays Egyptian regulations require the cheese to be made from pasteurized milk for hygienic reasons and for consistency purposes. The aim of the present communication was to develop cheese culture mixtures for Ras cheesemaking. Cultures isolated, identified and selected in the Laboratory of Biochemistry of Dairy Microorganisms were evaluated during Ras cheesemaking. The cheese was made according to the conventional method and analyzed for chemical composition. Free fatty acids (FFA) and free amino acids (FAA) were determined to follow the ripening process. The resultant cheese was also evaluated for organoleptic properties. The variations were statistically analyzed during cheesemaking and ripening. Starter or non-lactic acid bacteria did not influence cheese composition during manufacture or ripening. On the other hand, levels of FFA, FAA correlated well with the rate of ripening and flavor intensity of Ras cheese. Several of the tested mixtures produced the typical flavor and texture of Ras cheese. The highest overall score of flavor intensity, flavor and texture acceptability was detected in the cheese made using a commercial starter in addition to an adjunct mixture isolated from the Egyptian dairy environment composed of several lactobacilli in addition to *Enterococcus faecium*.

Key Words: Ras Cheese, Starter Culture, Lactobacilli

822 Microbiological evaluation of commercial cream cheese. A. Losambe* and P. S. Kindstedt, *University of Vermont*, *Burlington*.

Currently, the literature contains very little information relating to the microbiological characteristics of commercial Cream cheese. Furthermore, little is known about the potential for microbial-induced syneresis in commercial Cream cheese. The objective of this research was to evaluate microbiological characteristics of commercial Cream cheese samples during refrigerated storage and under temperature abuse conditions. Retail samples of Cream cheese representing three different brands were obtained from local sources. Three retail samples of each brand, each with a different expiration date, were obtained and stored at 4°C. Split samples were evaluated for aerobic plate count (APC) and aerobic spore count (ASC) immediately upon receipt (≥60 d before expiration) and again on the expiration date printed on the package. Also, split samples were subjected to temperature abuse at 20°C for 14 d and then enumerated for APC and ASC. Effects of storage time (at receipt v. at expiration) and temperature abuse on microbial counts were evaluated ANOVA using a repeated measures design. Upon receipt, all 3 brands of Cream cheese had very low APC values (1.70±1.56 log CFU/g) which did not differ significantly among the 3 brands. Similarly, initial ASC values were also very low (1.50±1.47 CFU/g) and did not differ among brands. APC and ASC values at the expiration date did not differ significantly from their initial values, indicating little or no microbial growth during storage at 4°C for ≥60 d. Similarly, APC and ASC values after temperature abuse at 20°C for 14 d did not differ significantly from the initial values. None of the samples displayed any visible syneresis at the expiration date or after temperature abuse. In summary, all of the samples resisted syneresis and had very low microbial counts, comprised mostly of aerobic spore formers, which remained low throughout product shelf life and during temperature abuse.

Key Words: Cream Cheese, Microbiology, Syneresis

823 Microbiological and sensory characteristics of Prato cheese obtained from milk with different levels of somatic cells. P. C. B. Vianna[1], G. Mazal[1], M. V. Santos*[2], H. M. A. Bolini[1], and M. L. Gigante[1], [1]*State University of Campinas*, *Campinas, São Paulo, Brazil*, [2]*University of São Paulo*, *Pirassununga, São Paulo, Brazil*.

Mastitis, an inflammatory reaction of the mammary gland, is characterized by increased somatic cell count (SCC) and by the higher concentrations of antimicrobial substances in milk. Antimicrobial

substances, originating from blood or secreted by somatic cells, may influence the growth and metabolism of starter bacteria used in cheese production. The objective of this research was to evaluate the effect of two levels of raw milk SCC on microbiological and sensory characteristics of Prato cheese, during ripening. Two groups of animals were selected to obtain milk with low (≤200,000 cells/ml) and high (≥700,000 cells/ml) SCC. Prato cheese was manufactured by traditional method and evaluated after 3, 9, 16, 32 and 51 days of storage for lactic bacteria, psychrotrophs, and yeasts and moulds counts. A 2x5 factorial design with four replications was performed. The sensory evaluation of cheeses with low and high SCC was carried out for firmness and taste attributes using nine points just right scale and for general acceptance using hedonic scale of nine points after 8, 22, 35, 50 and 63 days of storage. The SCC level only affected the lactic bacteria count of the cheeses. Cheeses produced with the low-SCC milk presented, in average, higher lactic bacteria count than cheeses produced with the high-SCC milk. A negative effect of time of storage was observed in lactic bacteria and psychrotrophic counts, while yeast and moulds counts were increased during storage time. Interaction of SCC x storage time significantly affected the lactic bacteria count. The presence of antimicrobial factors may be responsible for lower counts and the behavior of the lactic bacteria in cheeses produced with high SCC milk. Cheeses produced with the low-SCC milk had better overall acceptance in sensory evaluation by panelists, which may be explained by differences in firmness and flavor of the cheeses during storage time.

Key Words: Somatic Cell, Prato Cheese, Microbiological Characteristics

824 Effect of temperature abuse on water-holding capacity and microbiological characteristics of commercial cream cheese and cream cheese spread. A. Losambe* and P. S. Kindstedt, *University of Vermont*, *Burlington*.

Previous laboratory-scale studies have suggested that microbial growth in Cream cheese during refrigerated storage or as a result of temperature abuse may contribute to the development of syneresis defect, a costly problem for the industry. Cream cheese spread is higher in moisture than Cream cheese and typically has sorbic acid added as a preservative. Little is known about the potential for microbial-induced syneresis in commercial Cream cheese and Cream cheese spread. The objective of this research was to evaluate the water-holding capacity and microbiological characteristics of commercial Cream cheese and Cream cheese spread samples before and after temperature abuse. Three retail samples of Cream cheese and Cream cheese spread representing 3 different brands were obtained from local supermarkets. All samples had ≥60 d remaining before expiration. Split samples were stored at 20°C for 14 d and evaluated before and after storage for aerobic plate count (APC), aerobic spore count (ASC), and expressible serum (ES), obtained by centrifugation at 12,500 x g for 75 min at 25°C. Typical colonies were picked from APC and ASC and identified using the RiboPrinter® system. Effects of cheese type (Cream cheese v. Cream cheese spread) and temperature abuse on ES and microbial counts were evaluated by ANOVA using a repeated measures design. Upon receipt, Cream cheese and Cream cheese spread samples had very low APC (1.80±1.49, 1.66±.32 log CFU/g) and ASC (1.53±1.0, 1.43±0.9 log CFU/g) values, which did not differ significantly. APC, ASC and ES values before and after temperature abuse did not differ significantly. Colonies picked from APC and ASC were identified as Bacillus pumilus, Bacillus cereus, Bacillus subtilis and Bacillus lichenformans. In summary, all of the samples had very low microbial counts, comprised mostly of aerobic spore formers, which remained low despite temperature abuse. Temperature abuse did not cause a loss of water-holding capacity in these microbiologically stable samples.

Key Words: Cream Cheese, Microbiology, Syneresis

825 New alternative approaches to study cheese microstructure. M. Caccamo*[1], G. Impoco[2], F. Zanini[3], G. Tromba[3], P. Campo[1], S. Carpino[1], and G. Licitra[1,4], [1]*CoRFiLaC, Regione Siciliana*, *Ragusa, Italy*, [2]*IPLAB, University of Catania*, *Italy*, [3]*Sincrotrone Trieste S.C.p.A.*, *Trieste, Italy*, [4]*D.A.C.P.A. University of Catania*, *Italy*.

Scanning Electron Microscopy (SEM) is nowadays widely used to study and characterize cheese microstructure. SEM imagery offers the advantage of high resolution digital scanning. Several recent studies have applied computerized systems of image analysis to SEM images in order to obtain quantitatively valuable features of cheese microstructure. Nevertheless SEM maps a 3D structure of the scanned surface to a 2D. It does not allow therefore direct in-depth measurements. Two alternative approaches are proposed to overcome the problem of lack of information and creation of artifacts due to sample preparing techniques for SEM analysis. The microstructures of 9 Sicilian cheeses (5 pressed and 4 pasta filata) were analyzed using stereoscopy applied to SEM images and X-ray microtomography techniques. Stereoscopy mimics the characteristics of the human visual system by reconstructing 3D information from 2D images that are required to partially overlap. Two images of the same sample were taken with a small displacement (3mm vertically, 4mm horizontally). These scans are accurately aligned such that the structures in small overlapping areas match between different images. 3D models of the scanned cheese surface were generated using a software system that mimics human binocular vision. X-ray microtomography does not require a special sample preparation. This technique allows to obtain a 3D representation of the inner structure of a sample from a set of projection measurements recorded from a certain number of points of view. In the common case of X-ray absorption tomography, the structure of the object under study is represented by the linear attenuation coefficient, which is proportional to the mass density. The microtomographic investigations were carried out using the SYRMEP beamline of the Elettra Laboratory in Trieste, Italy. The samples, mounted on a rotation stage, were illuminated by monochromatic radiation (E = 16 KeV). For each tomographic set 1440 projections of the sample were acquired for equally spaced rotation angles and measurement times of 1 s over a total rotation of 180 degrees. The final result was visualized by 3D rendering by 2D slices using the ImageJ software.

Key Words: Microstructure, Stereoscopy, X-ray

826 Enhancement of flavour profile of cheddar cheese using microencapsulated enzymes. K. Kailasapathy* and S. Seneweera, *University of Western Sydney*, *NSW, AUSTRALIA*.

To accelerate cheese ripening and to improve cheese flavour, exogenous enzymes are used in the cheese industry. Direct addition of free enzymes however, leads to premature proteolysis, glycolysis, and

lipolysis. The aim of our study was to develop an efficient hydro-gel enzyme encapsulation process for the controlled release of flavour-enhancing enzymes into the cheese matrix, and to study proteolysis during cheese ripening using a reverse-phase HPLC. Flavourzyme (commercial protease-peptidase enzyme mixture from Novozymes Pty. Ltd) when encapsulated using 1.8% (w/v) alginate and polymerised in 0.1M calcium chloride solution and 0.1% (w/v) chitosan solution, produced 72% encapsulation efficiency. When the hydro-gel capsules containing enzymes were incorporated during cheese manufacture, the enzymes were released and accelerated cheese ripening. Four batches of cheddar cheese were prepared without enzyme (control) and with encapsulated enzyme. Sampling was carried out during various stages of cheese ripening (0, 1, 7 and 10 weeks) to assess ripening. Free amino acid, water soluble and insoluble fractions of nitrogenous compounds in the ripening cheese were separately analysed by RP-HPLC and SDS-PAGE. Addition of encapsulated enzyme accelerated the cheese proteolysis by producing a large number of low to medium size molecular mass peptides in the water soluble nitrogenous fraction, some of which were unique for the enzyme treated cheese. In contrast, analysis of water insoluble nitrogenous fraction showed that hydrolysis of casein after 70 days of maturity was greater in enzyme treated cheese. Particularly, beta-casein degradation was rapid compared to alpha-casein and kappa-casein in the enzyme treated cheese. This study showed that alginate microcapsules can be effectively used to release flavour enhancing enzymes into cheese matrix to accelerate ripening and improve the flavour profile of cheddar cheese

Key Words: Cheddar Cheese, Microencapsulation, Accelerated Cheese Ripening

Dairy Foods: Milk Proteins and Enzymes: Proteomics and Milk

827 Recent developments in proteomics: Implications for dairy protein research. P. Qi*, *USDA-ARS-ERRC*, *Wyndmoor, PA*.

Proteomics, the systematic study of the identities, quantities, structures, and biochemical and cellular functions of all proteins in a cell, tissue or organism, promised a rapid transformation for biological and medical research in the post-genomic era. Tremendous progress has been made over the past decade in this highly mass spectrometry dependent discipline of systems biology. Proteomics is regarded as a comprehensive research tool not only capable of identifying and quantifying large sets of proteins but also can be used to determine their localization, interactions, modifications, activities, and functions. Recent developments in proteomics research that include protein separation methods, mass spectrometric instrumentation, computational analysis, and integrative databases will be reviewed with the focus on post-translational modifications. In light of the current status and the perspectives of proteomics applications, we will discuss the implications for future dairy protein research suc as structural and functional studies of milk fat globule membrane proteins and other low abundance yet biologically important proteins in milk and dairy products.

Key Words: Proteomics, Post-translational Modification, Milk Proteins

828 Quantitative proteomic analysis of bacterial enzymes released in cheese during ripening. V. Gagnaire, D. Molle, J. Jardin, and S. Lortal*, *INRA*, *Rennes, France*.

Bacterial ecosystems contribute to the cheese ripening not only during their growth but also after their lysis, through the release of numerous proteins in the cheese curd, including enzymes. A prefractionation method allowing the isolation of bacterial proteins from cheese extracts was previously developed as well as a proteomic qualitative survey during Swiss cheese ripening (Gagnaire et al., 2004. Int. J. Food Microbiol.,94,185). Numerous peptidases coming from the lactic starters were identified on 2D-gel electrophoresis as well as many glycolytic enzymes and stress proteins. This new insight even if very informative provided only qualitative data. The aim of this work, using new iTRAQ technique (isobaric tagging reagent for quantitative proteomic analysis), was to provide quantitative proteomic data about the bacterial proteins released at different stages of ripening. This technique is based upon chemically tagging the N-terminus of peptides generated from protein digests, which are then fractionated by nanoLC and directly analysed by tandem mass spectrometry.

Experimental Swiss cheeses were performed in our laboratory using microfiltered milk in order to remove the initial bacterial raw milk contamination. Thermophilic lactic acid bacteria (L. helveticus LH1 and S. thermophilus ST20) and propionibacteria (P. freudenreichii P23) were used as starters. At four times of the ripening (day one, entrance, middle and end of the warm room ripening), cheese aqueous extracts were prepared and fractionated to separate bacterial proteins. To standardize the protein content of each sample before proteomic analysis, a total amino acid analysis was performed. The standardized samples were i) analysed by 2D-electrophoresis for qualitative analysis and ii) submitted to trypsinolysis. Each tryptic hydrolysate was labelled with a specific iTRAQ tag (one tag per ripening time) and submitted to a LC-ESI-MS/MS analysis. This technique provided the identification of the bacterial proteins released and their respective abundance at different times of the ripening.

Key Words: Proteomic, Cheese, Enzyme

829 Animal Science Image Gallery – A Source for poultry images. J. B. Hess* and W. D. Berry, *Auburn University*, *Auburn, AL*.

The Animal Science Image Gallery was created to provide images to middle school, high school and university teachers wishing to include images of animal agriculture in their courses. With limited expertise in poultry at the university level in some regions, a reference site of poultry and/or poultry industry images would be a useful teaching tool nationally. The Animal Science Image Gallery was designed to fill this role. Each image on the site comes with a limited description so that educators can select correct images for the course content. Subject editors review each image and the corresponding text for accuracy and appropriateness. Within the poultry portion of the Image Gallery, subcategories include; anatomy and physiology, disease and pathology, housing and equipment, poultry processing and poultry species and breeds. To date, the poultry site does not have a wide range of images available to offer coverage of the many types of poultry operations in the U.S. In addition, little has been uploaded regarding poultry physiology and disease. Please consider uploading images to the site commensurate with your area of expertise. Access the Animal Science Image Gallery at http://cygnet.richmond.edu/image_gallery to browse or upload images. Contributing to the Image Gallery will ensure that agricultural and science instructors will have quality poultry science materials to draw from in organizing lectures on poultry related topics.

Key Words: Teaching, Images, Poultry

830 National training program on depopulation and disposal procedures for avian influenza infected poultry flocks: An extension success story. G. Malone*[1] and N. Tablante[2], [1]*University of Delaware*, *Georgetown*, [2]*University of Maryland*, *College Park*.

Following an outbreak of low pathogenic H7N2 avian influenza (AI) on the Delmarva Peninsula in 2004, it became apparent that others could benefit from our successful response and the knowledge gained in the depopulation and disposal of these flocks. With support from the USDA-CSREES, a comprehensive training program was developed based on lessons-learned from our experience and others who have dealt with an AI outbreak. This half-day program was offered from 2005-2007 and was continually updated as new information became available. Information discussed in this training included a historic and current review of the AI situation, human health requirements for responders, and the various options and procedures for mass depopulation and carcass disposal for infected breeder, broiler, turkey and cage layer flocks. A total of 33 sessions were held in 26 different USA poultry producing states with ~2000 key poultry industry, agencies, university and private industry personnel in attendance. With the recent heightened awareness to AI and the need for developing response plans for a potential outbreak, the feedback from this training was highly favorable and very timely. Areas identified as most helpful were an understanding of the intricacy of responding to an AI outbreak based on real-world experiences, mass depopulation techniques with a particular interest in water-base foam as an emerging technology, and in-house composting as one of the most viable disposal options. This training has made participants aware of the need and complexity of being prepared to rapidly respond to an AI outbreak in order to effectively and quickly eradicate the disease. As a measure of success, this extension program has provided direction and help shape how we respond to AI in the USA using the most appropriate mass depopulation and disposal methods for the different situations that might be encountered.

Key Words: Avian Influenza, Mass Depopulation, Carcass Disposal

831 Educating livestock producers on the impacts of temporary feeding sites by the use of a novel mobile rain fall demonstration trailer. K. W. Harborth*, J. M. DeRouchey, T. T. Marston, and J. P. Harner, *Kansas State University*, *Manhattan*.

The use of temporary winter feeding sites is very common during the late winter and early spring months to supply feed and/or water to livestock. While most small producers do not feel environmental deterioration can occur from these sites, improper placement or management in fact can impact the surrounding environmental quality. In order to educate livestock producers on the impact that feeding sites can have on feed utilization, animal health and performance, stable fly production and environmental quality, a mobile demonstration trailer was designed and constructed in 2005. The demonstration equipment was designed and constructed on a 16' bump hitch trailer. The demonstration involves a rainfall event (up to 3" in 15 min) on a mixture of forage and manure to illustrate typical combinations at a feeding site. Excess moisture from the rain fall event is collected both from seepage (6" deep mixture) and from surface runoff. Once the water is collected, visual observation as well as rapid analysis for nitrates, ammonia, pH, turbidity, total solids and bacteria using quick test procedures can be performed. This demonstration has impacted over 3,000 producers from 80 Kansas counties as well as 5 different states in 2005 and 2006. For ease of use, table top demonstration units have been developed in 2007. These units will improve the ease of use for indoor events and new educational opportunities for small acreage educational events. In conclusion, the mobile rain fall demonstration trailer provides a means to practically and interactively educate producers on the implications of using winter feeding sites by providing an educational opportunity to recommend best management practices for their use.

Key Words: Water Quality, Winter Feeding sites, Extension

832 The effect of tillage practice and corn stalk grazing on crop yields. W. A. Griffin*[1], T. J. Klopfenstein[1], G. E. Erickson[1], W. Luedtke[2], and M. A. Schroeder[2], [1]*Universtiy of Nebraska*, *Lincoln*, [2]*Agricultural Research and Development Center*, *Ithaca, NE*.

A nine year study was conducted to determine the effect of four different tillage practices and spring grazing of corn stalk residue on crop yields in a corn-soybean crop rotation. The fields used were a combination of fine sandy loam and silty clay loam soil types. The four tillage practices used were: 1) pre-corn till (soybean residue tilled in the fall prior to the planting of corn; PCT), 2) ridge till (RT), 3) no-till (NT), and 4) spring till (corn residue tilled prior to planting of soybeans; ST). Additionally, steers were allowed to graze half of the corn stalks at a 2.5 times stocking rate for 60 d (Normal stocking rate = 0.32 hectares/steer for 60 d) and yields were compared to determine

the effects of corn stalk grazing on corn and soybean yields. Corn yields for NT (13,720 kg/ha), ST (13,635 kg/ha), and RT (13,823 kg/ha) were similar (P = 0.30); however, PCT had a negative impact on corn yield (11,832 kg/ha; P < 0.01). Soybean yields were similar (P = 0.06) for NT (3907 kg/ha), ST (3880 kg/ha), and RT (4005 kg/ha); however, PCT (4332 kg/ha) had a positive effect on soybean yields (P = 0.05). Spring grazing corn stalks did not have any effect on corn yields (13,250 vs. 13,275 kg/ha; P = 0.72). Additionally, soybean yields (4081 vs. 3987 kg/ha) were not different (P = 0.12) for grazed plots compared to ungrazed plots. In this study, utilizing pre-corn till had a negative impact on corn yield (13,726 vs. 11832 kg/ha; P = 0.05), and a positive impact on soybean yield (3931 vs. 4332 kg/ha; P < 0.01). However, grazing corn stalk residue at a 2.5 times stocking rate in the spring had no impact on corn or soybean yield. additionally, in this study, muddy conditions in the field that arise from spring grazing corn stalks had no effect on corn yield.

Key Words: Corn Stalk Grazing, Crop Yields, Tillage

833 Evaluation of storage methods for wet distillers grains plus solubles with forages and byproducts in silo bags and bunker silos. D. R. Adams*, T. J. Klopfenstein, and G. E. Erickson, *University of Nebraska*, *Lincoln*.

Two different experiments were conducted to determine methods to store traditional wet distillers grains plus solubles (35% DM; WDGS), because WDGS will not store in silo bags under pressure or pack into a bunker. The first experiment evaluated 3 forage sources as well as wet corn gluten feed (WCGF) or dry distillers grains mixed with WDGS. The product was mixed using feed trucks and was placed into a 2.74 meter diameter silo bag. During bagging, the bagger was set at a constant pressure of 21.09 kg/cm2. The height of the silo bag was a determining factor of storability. While continuing to bag the product, adjustments to the inclusion level of the feedstuffs were made based on the shape of the bag. Inclusion levels ranged from 7.5% to 25% forages and 40% to 60% corn byproducts. The silo bag split open at the 7.5% grass hay: 92.5% WDGS and 10% grass hay: 90% WDGS levels and also at the 40% WCGF: 60% WDGS and 50% WCGF: 50% WDGS (DM basis). The recommended levels for bagging are 15% grass hay: 85% WDGS, 22.5% alfalfa hay: 77.5% WDGS, 12.5% wheat straw: 87.5% WDGS, and 50% dry distillers grains: 50% WDGS (DM basis). The second experiment was conducted by mixing grass hay with WDGS stored in a concrete bunker. Two ratios were evaluated including 30:70 and 40:60 grass hay: WDGS (DM basis). Both levels packed into the bunker with the skid loader. A skid loader with tracks, which was used in this experiment, may require less hay compared to commercial conditions using heavier equipment. In both experiments, the product was stored over 45 days and the apparent quality didn't change. Forages should be compared based on the fiber content, with lower amounts of forage needed for more fibrous feeds. Appropriate conversions to an as-is basis is important because WDGS contains 65% water, meaning the percentage of WDGS on an as-is basis will be even greater. In conclusion, WDGS can be stored in a silo bag or bunker silo when mixed with drier or bulkier feedstuffs.

Key Words: Forages, Storage, Wet Distillers Grains

834 Evaluating the Alabama beef quality assurance program. W. F. Owsley*, H. D. Dorough, and J. D. Gladney, *Auburn University*, *Auburn*.

The Alabama Beef Quality Assurance program reached 1100 beef producers in 2005 to 2006. To evaluate the educational component of the program, all participants were asked to complete a pre-test and a post-test. Three questions on the test were designed to further evaluate the understanding of the veterinarians' role in production. Each examination contained the same 20 questions. All questions were taken from the 2 hour Beef Quality Assurance oral presentation. The average score on the pre-test was 13.8 correct. On the post-test, producers averaged 18 correct answers. The most frequently missed question on the pre-test related to the ideal yield grade. Sixty percent of producers missed the question on the pre-test. Only 3 percent missed the same question on the post-test. Three questions asked about veterinarian-client-patient relationships and prescriptions. Fifty percent of the responses on the pre-test were incorrect, while only 21 percent of the responses to the post-test questions were incorrect. Based on the changes in test scores, beef producers appeared to have a better understanding of Beef Quality Assurance following the oral presentation. However, over 20 percent did not have a good understanding of the veterinarians' role and/or responsibilities.

Key Words: Beef Quality Assurance, Evaluation, Producers

835 Evaluation of a total ranch management workshop as an educational tool to transfer technology in Mexico. R. Teliz-Triujeque*[1,2], R. H. Williams[2], J. A. Ortega-Santos[2], C. W. Hanselka[3], E. A. Gonzalez-Valenzuela[1], J. A. Hinojosa[2], and R. L. Stanko[2], [1]*INIFAP*, *Mexico*, [2]*Texas A&M University*, *Kingsville*, [3]*Texas Cooperative Extension*, *Corpus Christi*.

The total ranch management (TRM) planning process is an approach to help ranchers maintain better control of the ranch and its future, and is based on the idea of management achievements rather than specific management practices. The objectives of this study were to 1) evaluate the effect of a TRM workshop as a method of technology transfer, 2) determine impressions of participants, 3) determine extent of learning, and 4) determine comprehension and utilization of information. Mexican ranchers (n=20) interested in technology transfer attended a 6-d workshop taught by 6 U.S. instructors in 2 sessions. The information was divided into 8 themes and adapted from Texas Cooperative Extension's Total Ranch Management program. Participants were asked to complete a confidential 45-question survey to identify demographics and background knowledge of TRM issues and elements, a 9-question evaluation of each session and instructor, and a 13-question evaluation of the entire workshop. Eleven mo. after the workshop, ranchers were revisited to apply a 26-question, post evaluation survey. Workshop evaluations were analyzed using descriptive statistics and t-Test. Major enterprises of workshop participants included: cow/calf (63%), stockers (13%), registered cattle (57%), and wildlife (40%). Level of understanding of all topics was greater (P<0.01) after as compared to before the workshop. Total mean change in understanding concepts of strategic planning, ranch resources, economics, livestock production, wildlife management, and grazing management were 65, 48, 39, 54, 63, and 54%, respectively. TRM as a program has proved to be both a platform to convey and continue education and improve

decision making processes in ranch management. Mexican ranchers are welcoming through TRM a technology transfer mechanism that was not in place.

Key Words: Technology Transfer, Total Ranch Management, Mexico

836 Summary of the 2004 – 2005 University of Georgia Master Cattlemen's Programs. T. W. Wilson*[1], J. E. Rossi[1], R. C. Lacy[1], M. E. Pence[1], J. Andrea[2], R. E. Silcox[1], D. Ensley[1], R. L. Stewart[1], J. W. Worley[1], N. C. Hinkle[1], and J. C. McKissick[1], [1]*The University of Georgia*, *Tifton*, [2]*Clemson University*, *Clemson, SC*.

One hundred and seventy-six participants attended the four Master Cattlemen's programs offered during 2004 and 2005 by The University of Georgia's Beef Team. These programs incorporated speakers from six departments within two colleges. One multi-county program was offered during each six month period and was rotated within the four Extension Districts in Georgia. Each program met for a total of seven sessions that included either one or two speakers for a total of two hours. Program topics were customized by season and location. Participants received a notebook complete with materials from speakers, and those that attended five of the seven sessions received a program hat and a certificate of completion. Evaluations were collected after the completion of three of the four programs, and a one year post-meeting survey was conducted with all four programs to determine impact. Across the three that were evaluated, the overall program was rated 4.5 (scale 1 to 5; 5 = best; n=80) and the average speaker evaluation was rated 4.2. The one year post-meeting survey (n=60) indicated that 95% of the respondents were commercial, while 5% were purebred operators. Sixty-eight percent of participants surveyed indicated that they derived 0 to 25% of their gross income from their beef operations; 27% received 26 to 50%; the remaining 5% received between 51 to 100%. Fifty-two percent of participants indicated they had an impact in revenue ranging from $0 to $5,000; 5% indicated they received from $5,001 to $10,000; 17% indicated no change in revenue from this program. When asked which of the management strategies they incorporated or made improvements in, 42% indicated improvements in record-keeping; 12% EPDs; 27% vaccinations; 27% feeding options; 38% pasture management; 35% reproduction; 22% fly control; 17% facilities; 20% hay storage; and 60% general herd management. Of the participants that returned the survey, 98% indicated that the information they received from this program improved their ability to successfully raise beef cattle, and 100% indicated that they would recommend this program to other beef producers.

Key Words: Beef Cattle, Extension Programming

Forages and Pastures - Livestock and Poultry: Grazing

837 Copper and Cu/Zn superoxide dismutase status in steers grazing three fescue types. R. L. Stewart, Jr*, G. Scaglia, W. S. Swecker, Jr., J. P. Fontenot, A. O. Abaye, J. H. Fike, M. A. McCann, and E. A. Wong, *Virginia Polytechnic Institute and State University*, *Blacksburg*.

During two consecutive grazing seasons, a study was conducted to measure Cu status of steers grazing three tall fescue (*Festuca arundinacea*) types: 'Kentucky-31' endophyte-infected (E+) and endophyte free (E-) tall fescues, and Q4508-AR542 non-ergot alkaloid-producing endophyte-infected tall fescue (Q). In 2004, forage Cu concentration was greater ($P < 0.05$) in E-. No differences in forage Cu were observed among treatments in 2005 ($P = 0.19$). In 2004, Cu intake was highest ($P < 0.001$) for steers grazing E- and lowest for E+ but was similar across treatments in 2005. Serum Cu was not different among treatments in 2004 ($P = 0.81$), but in 2005, serum Cu of steers grazing E- and Q was higher than E+ ($P < 0.05$). In 2004, liver Cu levels of cattle grazing E- were higher ($P < 0.05$) than for those grazing E+, while liver Cu levels of steers grazing Q were intermediate. No differences were detected among treatments in 2005 ($P = 0.86$). Enzymatic activity of Cu/Zn superoxide dismutase (SOD) did not differ among treatments in 2004 or 2005 ($P = 0.79$ and 0.80, respectively). In 2004 and 2005, no difference in relative Cu/Zn SOD mRNA abundance was observed among treatments ($P = 0.33$ and 0.92, respectively). These results suggest that lower Cu intake of steers grazing E+ and Q was related to lower DMI on these pastures. The lower Cu intakes likely contributed to differences in liver Cu. Endophyte status of forage did not affect Cu/Zn SOD enzymatic activity or relative mRNA abundance.

Key Words: Beef Cattle, Copper, *Festuca arundinacea*

838 Effects of clipping and implants on rates of hair growth and sweating, and rectal temperature of steers grazing endophyte-infected tall fescue. L. K. McClanahan*[1] and G. E. Aiken[2], [1]*University of Kentucky*, *Lexington*, [2]*USDA-ARS, Forage-Animal Production Research Unit*, *Lexington, KY*.

The effects of hair coat clipping and steroidal implants on rectal temperatures, rates of sweating and hair growth of beef steers grazing endophyte infected tall fescue [Schedonorus arundinaceus (Schreb.) Dumort; Soreng et al., 2001] were determined. Steers were stratified by body weight and hair coat color before initiation of grazing on six, 3.0-ha pastures of endophyte-infected 'Kentucky 31' tall fescue on 3 May, 2006. Ten clipped and 10 unclipped steers were assigned to pastures as the two main plot treatments. Five steers in each pasture were implanted with Synovex-S (200 mg progesterone-20 mg estradiol) and five were implanted with Compudose (25 mg estradiol) and handled as sub-plots. Thirty to 40% of body surface of clipped steers was shaved with surgical clippers. A small area over the shoulder of all steers also was clipped to measure hair length growth rate and sweating rate (g/m2/h). These variables and rectal temperature were measured at 28, 56, 84, and 104 days of grazing. Rectal temperatures for clipped steers were not lower ($P > 0.10$) than for unclipped steers, except at 84 days when the highest mean ambient temperature (33°C) was recorded (clipped = 39.5°C, unclipped = 39.3°C; $P < 0.05$). Sweating rate declined ($P < 0.001$) as ambient temperatures increased. Sweating rates tended ($P > 0.10$) to be higher with the estradiol than the progesterone-estradiol implant. Hair growth rates averaged 0.28 mm/d and were unaffected ($P > 0.10$) by the treatments. Results indicated that retention of rough hair coats, continuous growth of hair, and a reduction in sweating rate at higher ambient temperatures are factors that contribute to the vulnerability of fescue cattle to heat stress during the summer.

Key Words: Tall Fescue, Fescue Toxicosis, Heat Stress

839 Comparison of novel endophyte tall fescues for stocker cattle in southern Arkansas. P. A. Beck*[1], C. B. Stewart[1], D. Singh[2], and S. A. Gunter[1], [1]*University of Arkansas SWREC*, *Hope*, [2]*Barenbrug USA*, *Tangent, OR*.

Calves grazing Kentucky-31 (KY-31) tall fescue often exhibit signs of fescue toxicosis caused by ergot alkaloids produced by fungal endophytes. These fungal ergot alkaloids enable the tall fescue to be highly persistent in harsh conditions. Performance of calves grazing Endophyte-free (EF) tall fescue is improved but plant persistence is reduced. Novel endophyte (NE) tall fescues combine the advantages of plant persistence with the increased animal performance of fescues not containing the endophytes. Eleven 0.81-ha pastures (Una silty clay loam) were sprayed with 4.7 L glyphosate/ha 2 times at a 6-wk interval and no-till seeded with EF (Barcel®, Barenbrug USA, Tangent, OR), NE (Jessup AR542, MaxQ®, Pennington Seed, Madison, GA; and BAR FA BE 9301A, Barenbrug USA), and KY-31 tall fescues in the fall of 2005 to evaluate plant persistence, forage production, and animal performance. Calves (BW = 227 ± 6.7 kg, n = 3/pasture) grazed pastures from 4 January 2005 until 24 May (EF) or 21 June (KY-31 and NE). Calf BW at the end of grazing was 14% greater ($P < 0.01$) EF or NE than KY-31. Average daily gains were least ($P < 0.01$) for KY-31 (0.59 kg). Daily gains of calves grazing EF were greater ($P = 0.05$) than Jessup AR542 and tended ($P= 0.07$) to be greater than BAR FA BE 9301A, averaging 1.05, 0.83, and 0.88 ± 0.06, respectively. Total BW gain per calf and gain per ha were 33 and 34%, respectively, less ($P \leq 0.02$) for KY-31 than EF or NE tall fescues which did not differ ($P \geq 0.62$). Stand counts conducted during the grazing study indicate stand losses were already occurring for EF (32%) and were heavily contaminated with annual ryegrass, but stand counts of Jessup AR542, BAR FA BE 9301A, and Kentucky-31 were 75, 69, and 86%, respectively. The results of this experiment indicate that NE tall fescue pastures can improve animal performance compared to toxic endophyte tall fescue without the reduction in persistence observed for EF.

Key Words: Beef Cattle, Endophytes, Festuca arundinacea

840 Supplementation of digestible fiber and glucomannan to tall fescue pastures: performance, forage availability, and prolactin response. R. L. Mills*[1,2], C. J. Richards[2], F. N. Schrick[1], and J. C. Waller[1], [1]*The University of Tennessee*, *Knoxville*, [2]*Oklahoma State University*, *Stillwater*.

An 84 d randomized block design utilizing 96 weaned beef calves (238.8 ± 20.1 kg) in each of two consecutive years was used to assess the efficacy of digestible fiber and glucomannan (MTB-100®, Alltech, Nicholasville, KY) supplementation. Groups of four test calves were randomly assigned to 24 endophyte-infected tall fescue spring pastures (1.23 ± 0.06 ha) with additional grazer calves used in a put-and-take system. Pastures, blocked by previous productivity, were randomly assigned to one of five treatments: 1) no supplementation (CON); 2) supplemented with soybean hulls (SH) at 0.33% BW (DM basis; LO); 3) supplemented with SH at 0.66% BW (DM basis; HI); 4) LO plus 20 g•hd^{-1}•d^{-1} MTB-100®; and 5) HI plus 20 g•hd^{-1}•d^{-1} MTB-100®. Calves had free-choice access to water and a loose vitamin/mineral mix. Every 21 days, calves were weighed, serum was collected, and forage clip samples taken to estimate forage availability. Data were analyzed using the MIXED procedure in SAS with contrasts of main effects of SH level (LO vs. HI), MTB, SH level x MTB, and CON vs. supplemented (SUPP). No interaction between SH level and MTB was observed ($P > 0.10$). ADG increased by 0.24 kg/d with SUPP ($P < 0.01$). HI SH increased ADG by 0.13 kg/d ($P < 0.01$) over LO SH, but MTB had no effect ($P > 0.10$). Forage availability was only affected by day of collection ($P < 0.01$). HI SH had greater total gains per hectare than LO SH ($P < 0.01$). Serum prolactin differed on days 63 and 84 ($P < 0.01$) with concentration increasing by 52% due to SUPP ($P < 0.01$) and 34% by increasing from LO to HI SH ($P < 0.05$). Results indicate that digestible fiber supplementation can improve animal performance and endocrine function on endophyte-infected tall fescue. MTB showed no effect when included with SH supplementation.

Key Words: Tall Fescue, Soybean Hulls, Glucomannan

841 Performance of primiparous beef cows grazing bahiagrass pastures with three rates of soybean hull supplementation. J. M. B. Vendramini* and J. D. Arthington, *Range Cattle Research and Education Center - University of Florida*, *Ona*.

The objective of this study was to evaluate the performance and milk production of primiparous beef cows grazing bahiagrass (Paspalum notatum Flugge) pastures with three rates of soybean hull supplementation. The experiment was conducted at the Range Cattle Research and Education Center –Ona, FL from Aug. 14 2006 to Jan. 5 2007. The treatments were three rates of soybean hulls (0, 1.6, and 3.2 kg/head/d), in addition to a base supplement of 1.6 kg of molasses and 0.8 kg of cottonseed meal per head daily. Treatments were evaluated in a completely randomized design with four replications. Three Brangus-crossbred and one Braford cow were assigned to each experimental unit. The experimental units were 1.2 ha pastures. Heifer BW and body condition score (BCS) were recorded every 28-d. Calf BW and cow milk production were evaluated on Dec. 4 2006 and Jan. 1 2007. Milk production was measured using the weigh-suckle-weigh method. Herbage mass was measured every 14-d using the disk plate meter methodology. There was a treatment by time interaction on herbage mass ($P<0.05$). The control treatment had a greater decline in herbage mass (1400 to 950 kg DM/ha) than treatments receiving soybean hulls (1500 to 1200 kg DM/ha) from Aug. to Jan. Heifer ADG (-0.12 to 0.22 kg/d), BCS change (-0.65 to 0), milk production (4.2 to 6.6 kg/d), and calf ADG (0.60 to 0.88 kg/d) increased linearly ($P<0.05$) as rate of soybean hull supplementation increased. The Increased energy and protein supplementation of primiparous cows with soybean hulls increased BW of calves and BCS of cows; however, the economic feasibility of this management practice will depend upon soybean hull cost and calf prices.

Key Words: Milk Production, Soybean Hulls, Primiparous Cows

842 Grazing efficiency in free range Merino sheep. W. M. Rauw*[1], H. A. Glimp[1], W. Jesko[2], M. Sandstrom[1], and L. Gomez-Raya[1], [1]*Department of Animal Biotechnology, University of Nevada Reno*, *Reno*, [2]*Rafter 7 Ranch*, *Yerington, NV*.

Although the importance of grazing efficiency has been recognized, no practical method is available today to record grazing efficiency in grazing animals that can be used in a selection program. We propose a new method to measure grazing efficiency that can be selected for. Grazing efficiency as defined by our model is an estimate of the individual ability to graze at resource limiting rangelands and is

estimated from changes in body weight during a grazing period. The model was applied to a free range Merino and Merino × Rambouillet sheep herd with a total of 905 ewes. Body weights were measured before and after the ewes were allowed to graze freely on the rangelands for 75 days. The model is based on the expected metabolizable energy that they need for production, maintenance and reproduction in that period. The ewes grazed on average 2861 ME (kcal/d) with a standard deviation of 325 ME (kcal/d). Tests for normality (Shapiro-Wilk and Anderson-Darling) of the distribution of grazing efficiency indicated that this trait is normally distributed. The effect of the ewe's age was highly significant ($P < 0.001$) with younger ewes having the lowest grazing efficiency. Results showed that this is a size effect (older animals having higher requirements), but this may have a behavioral component as well with older animals having more grazing experience. The effect of sire was significant also ($P < 0.001$). Estimates of heritabilities for grazing efficiency and number of lambs were 0.340 (± 0.056) and 0.056 (± 0.046), respectively. The genetic and phenotypic correlations between grazing efficiency and number of lambs weaned were 0.168 (± 0.269) and 0.468 (± 0.027), respectively. Therefore, selection for grazing efficiency may result in a correlated response to number of lambs. The model of grazing efficiency may have a range of applications such as comparing grazing efficiency of different ruminant species, and providing information on the potential for grazing of different range ecosystems. It also has implications for animal welfare.

Key Words: Sheep, Grazing Efficiency, Selection

843 Glycerol as a supplemental energy source for meat goats.
K. R. Hampy*, K. P. Coffey, D. W. Kellogg, E. B. Kegley, J. D. Caldwell, M. S. Lee, M. S. Akins, J. L. Reynolds, J. C. Moore, and K. D. Southern, *University of Arkansas*, *Fayetteville*.

Glycerol, a by-product of the manufacture of bio-diesel, has potential for use as a feedstuff for cattle, sheep, and goats. Limited research reported that glycerol was fermented rapidly in the rumen and increased proportions of propionate, but decreased DM intake. Our objective was to determine the impact of adding different levels of glycerol on intake and digestibility of a medium quality crabgrass (Digitaria ciliaris (Retz.) Koel.)/ goosegrass (Eleusine indica (L.) Gaertn.) hay basal diet by meat goats. Twenty wether meat goats (23.5 ± 0.74 kg BW) were housed in individual pens (1.1 by 1.5 M) with expanded metal floors and offered one of four treatments (five goats each). Treatments consisted of a basal diet of medium quality crabgrass/goosegrass hay offered for free-choice consumption with no supplement (C), or with either 1) glycerol at 5% of the total diet (G5), 2) glycerol at 10% of the total diet (G10), or 3) liquid molasses at 10% of the total diet (M10). Diets were offered twice daily at 0800 and 1400h and liquid supplements were top-dressed onto the hay and mixed by hand at each feeding. Trace mineralized salt was provided at 0.5% of the total diet daily. Hay samples were collected at each feeding, and refused feed was removed daily at 0800h, weighed, and dried at 50 C for DM determination. Following a 10-d dietary adaptation period four goats per treatment were fitted with fecal collection bags and total feces were collected for 5 d. Feces were removed twice daily, weighed, then dried at 50 C. Total DM intake did not differ ($P > 0.33$) among treatments (11.5, 15.5, 11.4, and 12.6 g/kg BW for C, G5, G10, and M10, respectively). Digestibility of DM tended ($P = 0.10$) to be lower for C compared with G5, but other treatments did not differ (60.1, 66.2, 62.2, and 63.2% for C, G5, G10, and M10, respectively). Therefore, lower levels of glycerol may be used to increase digestibility of medium-quality forages without negatively impacting forage intake.

Key Words: Glycerol, Meat Goats, Crabgrass

844 Effects of level of concentrate supplementation on nutrient digestion of lactating dairy cows grazing at two pasture allowances.
T. H. Garmo, H. Volden, S. J. Krizsan*, and S. K. Nes, *Norwegian University of Life Sciences*, *Ås, Norway*.

The impact of low vs. high pasture allowance (PA) (12 vs. 24 kg DM/cow per d) within 2 levels of concentrate supplementation (C), 3 vs. 7 kg/d (C3 vs. C7) on digestion and rumen fermentation was evaluated in lactating cows grazing a white clover dominated pasture (percent coverage>60%). Four ruminally cannulated cows averaging 107±51 DIM and producing 36±10 kg milk/d pretrial were used in a change over experiment with four 15-d periods. The concentrate mix provided 190 g NDF and 334 g starch per kg of DM. Pasture CP and NDF were: 193 and 345 g/kg of DM. During the last 5 days of each period fecal, omasal digesta, rumen fluid and rumen evacuation samples were collected. Additionally, ruminal pH was measured continuously for 24 h. Pasture DMI was calculated from C31 and C32 alkane content. No significant interactions between PA and C were detected for any trait. Apparent digestibility of CP and NDF was higher for cows on low PA and cows fed C3, respectively. Ruminal NDF digestibility (RNDFD) decreased and ruminal K_pNDF, omasal OM and AA flow to the small intestine increased for cows fed C7 compared with C3. There were no treatment effects on total or individual VFA concentrations, but rumen NH_3 was lower for cows fed C7 than for cows fed C3. Ruminal pH was below 6 for 11 h compared to 1 h for cows fed C7 and C3 diets, respectively. Results indicate that energy is the first limiting nutrient for lactating cows grazing high quality pasture.

Table 1.

Item	PA		C (kg/d)		SEM
	Low	High	3	7	
DMI, kg/d	18.9	20.6	18.1	21.4	0.8
Pasture DMI, kg/d	14.5	16.2	15.6	15.1	0.7
App. dig. %					
OM	73.1	72.3	73.7	71.8	0.6
CP	74.0[a]	71.6[b]	73.8	71.8	0.8
NDF	54.0	53.5	57.6[a]	49.9[b]	1.5
K_pNDF, %/h	2.8	3.1	2.7[a]	3.2[b]	0.2
$K_d$pdNDF, %/h	4.5	4.6	4.8	4.3	0.3
RNDFD, %	50.0	49.6	52.1[a]	47.4[b]	1.7
Omasal OM flow, g/d	12840	13149	12455[a]	13534[b]	580
Omasal AA flow, g/d	2651	2801	2350[a]	3101[b]	170
Rumen NH_3, m*M*	7.6	9.4	11.3[a]	5.6[b]	2.0
Rumen total VFA, m*M*	110	117	112	115	11.8

[a,b]Means within a row with different superscripts differ ($P<0.05$)

Key Words: Concentrate Level, Nutrient Digestion, Pasture Allowance

845 Effect of daily herbage allowance and concentrate level, offered at different stages of lactation, on milk production, dry matter intake, blood metabolites, bodyweight and body condition score. E. Kennedy*[1,2], M. O'Donovan[1], F. O'Mara[2], and L. Delaby[3], [1]*Teagasc, Dairy Production Research Centre, Moorepark, Fermoy, Co. Cork, Ireland*, [2]*School of Agriculture, Food Science and Veterinary Medicine, UCD, Belfield, Dublin 4, Ireland*, [3]*INRA, UMR, Production du Lait 35590 St. Gilles, France*.

The objective of this study was to establish the influence of daily herbage allowance (DHA) and concentrate supplementation on milk production, dry matter intake (DMI), blood metabolites, bodyweight and body condition score (BCS) of spring calving dairy cows at approximately 40, 80 and 120 days in milk (DIM). Sixty-six (30 primiparous and 36 multiparous) Holstein Friesian dairy cows (mean calving date – 7 Feb) were randomly assigned to a 6 treatment (n=11) grazing study. Animals were offered one of 3 DHA′s (13, 16 and 19kg DM/cow/day >4cm; *Lolium perenne*) and either 0 or 4kg DM/day concentrate supplementation at 40 and 80 DIM. All animals were offered 20kg DM/cow/day of herbage and no concentrate at 120 DIM. Milk yield was recorded daily; milk composition, BW and BCS were determined weekly. Blood metabolites and DMI were measured at 40, 80 and 120 DIM. The experiment was a randomised block design and was analysed using covariate analysis. There was no effect of DHA on milk production at 40 DIM, however BW (P<0.01) and DMI (P<0.05) were lower when a low DHA was offered while plasma NEFA, BHB and urea concentrations were higher. DHA tended to influence animal performance at 80 DIM. A low DHA reduced BW (-21 kg) when compared to a medium and high DHA at 80 DIM but there was no effect of treatment at 120 DIM. Concentrate significantly increased milk production at 40, 80 and 120 DIM (+ 4.1, 5.9 and 1.2 kg/cow, respectively). It also increased total DMI but decreased grass DMI and plasma NEFA at 40 and 80 DIM. These results indicate that a low DHA in early lactation does not adversely affect animal performance however DHA needs to be increased as lactation progresses. Including concentrate in the diet increased animal performance throughout early lactation.

Key Words: Daily Herbage Allowance, Concentrate, Days in milk

846 Timing of herbage and fasting allocation in strip grazed cattle: Effects on patterns of ingestive behavior, herbage intake, and nutrient supply. P. Gregorini*[1], S. A. Gunter[2], and P. A. Beck[2], [1]*USDA–ARS, University Park, PA*, [2]*University of Arkansas SWREC, Hope*.

Afternoon herbage allocations have shown to improve animal performance due to an increase in intake at dusk, when herbage quality is higher. However, this trend might not yet be maximized. This work aimed to assess the impact of timing of herbage and fasting allocations on patterns of ingestive behavior, herbage intake, and ruminal fermentation, plus nutrient flow to the duodenum. Treatments were daily herbage allocation in the afternoon (1500, AHA), morning (0800, MHA), AHA plus 20 h of previous fasting (AHAF), and MHA plus 20 h of previous fasting (MHAF). Four ruminal and duodenal fistulated heifers (279 kg ± 99 kg BW) individually strip-grazed wheat (Ttriticum aestivum L.) pastures in a 4 × 4 Latin square design. Eating behavior was recorded every 2 min, and bite rate was measured every hour while heifers were in the strips (12 h MHA and AHA; 4 h MHAF and AHAF). Ruminal DM pools were measured 4 times daily (0800, 1200, 1500, and 1900) to determine daily herbage DMI and its pattern. Ruminal fluid was sampled at the same times plus at 2300. Duodenal digesta was sampled over 2 d. Samples were collected at intervals of 4 h for the first 24 hr. The second day collection times were advanced 2 h. Treatments did not affect daily herbage DMI (16.5 g/kg BW, SE 0.0025; P > 0.05). However, eating pattern was altered; evening grazing bout of AHA and AHAF was longer (P < 0.05) and more intense (P < 0.05; bite rate, bite mass and intake rate). Ruminal fermentation patterns followed the pattern of herbage intake. Non-glucogenic/glucogenic VFA ratio and ruminal pH were lower (P < 0.05) for AHA and AHAF during the evening. The flow of OM, N, microbial protein and non-microbial OM to the duodenum did not vary (P >0.05) among MHA, MHAF and AHAF; however, it was in average 970, 40, 300 and 540 g/d respectively greater (P < 0.05) for AHA. These results demonstrate that at the same level of resource allocation and herbage intake, nutrient supply to grazing cattle can be modified through simple grazing management.

Key Words: Eating Pattern of Cattle, Fasting and Herbage Allocation, Nutrient Supply

847 Frequent reallocation of strip grazing cows improves productivity. P. A. Abrahamse*, J. Dijkstra, and S. Tamminga, *Animal Nutrition Group, Wageningen University, Wageningen, The Netherlands*.

Twenty Holstein cows were split into two equal groups to test the effect of allocation frequency to new strip grazing plots on dry matter intake (DMI), grazing behaviour, rumen characteristics and milk production using a repeated measurements design with two periods of 12d. Treatments were daily allocation to 0.125 ha plots (1D) and every four days allocation to 0.5 ha plots (4D) of Lolium perenne L. Cows were fed 2.7 kg DM/d concentrates as a supplement. There were no differences in chemical composition of grass between 1D and 4D, but between offer and turnout leaf fractions decreased from 70.7% to 53.0% of grass DM, causing decreased CP and increased NDF grass contents. DMI determined using the n-alkane technique did not differ (p>0.05) between 1D and 4D but there was a significant (p=0.0253) treatment*period interaction (period 1: 1D 18.3 vs. 4D 16.5; period 2: 1D 14.7 vs. 4D 15.0 kg DM grass/cow/day), due to limited DM on offer in period 2. Grazing behaviour, observed using IGER graze recorders, showed no difference in eating time per day (561.8 min/day, p=0.5834), but bite mass was numerically higher in 1D than in 4D (490.7 vs. 440.2 mg/bite, p=0.2601). Between offer and turnout in 4D, eating time increased (548.2 to 572.3 min/d) and rumination time decreased (468.5 to 452.4 min/d). Ruminal ammonia concentration (NH_3) was significantly lower in 1D than in 4D (93.7 vs. 120.1 mg/L, p=0.0256), NH_3 decreased from 171.5 to 77.5 mg/L from d1 to d4 in 4D. There was no difference in milk urea between treatments, but milk urea decreased from 26.5 to 20.6 mg/dL from d1 to d4 in 4D. Fat and protein corrected milk (FPCM) was significantly higher in 1D than in 4D (24.0 vs. 21.9 kg/cow/day, p=0.0068), mainly due to a difference in milk production (25.0 vs. 23.0 kg/cow/day). The results show that more frequent reallocation of cows increases FPCM. DMI was higher in 1D when grass DM on offer was high, probably due to less variation in grazing behaviour between days. The difference in grass composition between days in 4D had major effects on NH_3 in rumen fluid and excretion of N with milk urea.

Key Words: Grazing Behaviour, Rumen Fermentation, Milk Production

848 Effect of sulphite salts on the aerobic stability and intake levels of whole crop wheat by grazing of dairy cattle. J. K. Margerison*[1] and R. R. Edwards[2], [1]*Massey University*, *Palmerston North, New Zealand*, [2]*University of Plymouth*, *Plymouth, UK*.

Two experiments were completed to measure the effect sulphite salts on the aerobic stability and intake levels of whole crop wheat (WSW) offered to grazing dairy cattle. In experiment 1: 40 cows (60 days postpartum), were allocated into matched pairs according to milk yield and composition: 20 received WSW with no additive (NoSS), 20 received WSW with added sulphite salts (SS) for 42 days, with a 28 day measurement period using pre-treatment milk yield and composition as covariates. In experiment 2: 1.5 kg of WSW from each treatment in experiment 1 was used for laboratory aerobic stability studies and plate yeast culture. WSW intake levels (kg DM/d) were significantly lower in SS 6.9, NoSS 5.9 (SE 0.19), grazing time (min/d) SS - 263.5, NoSS 296.0 (SE 6.911), ruminating time (min /d), SS 546.6, NoSS 530.8, 3.353 was significantly greater with NoSS. Diet had no significant effect on milk yield (kg/d), SS 33.3, NoSS 32.9, (SE 0.52), milk fat (g/kg), SS 40.5, NoSS 42.1, 0.07 or protein (g/kg), SS 33.6, NoSS 33.6 (SE 0.03) content. Mean live weight (kg) was significantly greater in SS cows, SS 666.81, NoSS 660.14 (0.823). Time to peak temperature (h), SS 128.64, NoSS 82.89 (SE 1.547), maximum temperature (°C), SS 6.76, NoSS 10.90 (0.372) heat generated (°C), SS 39744.0, NoSS 54938.0 (1171.00) and yeast numbers (NoSS 4.951, NSS 4.156 (SE 0.62) log cfu/ml) were greater with NoSS. In conclusion, silage quality, live weight gain and aerobic stability of WCW was increased by the addition of sulphite salts, but had no significant effect on milk yield.

Key Words: Aerobic Stability, Whole Crop, Wheat

Growth and Development - Livestock and Poultry: Transcriptional Factors and Cell Mechanisms for Regulation of Growth and Development with Application to Animal Agriculture

849 Defining the transcriptional signature of skeletal muscle stem cells. Z. Yablonka-Reuveni*, I. Kirillova, G. Shefer, K. Rider, R. Almuly, A. Vine, B. Kwiatkowski, and K. Day, *University of Washington*.

Skeletal muscle myofibers are supplied with new nuclei by satellite cells, myogenic progenitors located between the plasma membrane and the basal lamina of the myofiber. During postnatal growth, satellite cells proliferate and contribute myoblasts that fuse with the enlarging myofibers. In mature muscles, satellite cells are mitotically quiescent, but they can enter the cell cycle and produce myoblasts in response to stimuli generated by muscle damage. Quiescent satellite cells commonly express the paired-homeobox transcription factor Pax7, while their proliferating progeny co-express Pax7 and the muscle-specific transcription factor MyoD. Upregulation of FGFR4, along with the induction of the muscle-specific transcription factor myogenin and a concomitant decline in Pax7, marks the transition of satellite cell progeny into the differentiation phase. These cells rapidly withdraw from the cell cycle, terminally differentiate and fuse into myotubes. We identified expression of green fluorescent protein (GFP) driven by regulatory elements of the nestin gene within satellite cells of different muscles in mice. This GFP expression establishes a novel means for characterizing satellite cells in their niche. Sorted GFP+ cells exclusively acquired a myogenic fate, even when supplemented with media supporting non-myogenic development. Common and unique gene expression patterns were identified in satellite cells from different muscle groups. GFP+ sorted cells from hindlimb, diaphragm and extraocular muscles expressed relatively high levels of Pax7 and Myf5. Only the diaphragm cells exhibited a distinctly greater expression of Pax3. GFP expression declined following satellite cell activation and was reacquired in late stage myogenic cultures by non-proliferating Pax7+ progeny. The dynamics of this expression pattern reflect the cycle of satellite cell self-renewal. The nestin-GFP model reveals unique transcriptional activity within quiescent satellite cells and permits novel insight into the heterogeneity of their molecular signatures. Supported by USDA and NIH.

Key Words: Satellite Cells, Pax7, Skeletal Muscle

850 The role of microRNAs in muscle development. T. P. L. Smith*[1], T. G. McDaneld[1], M. E. Doumit[2], L. K. Matukumalli[3], T. S. Sonstegard[3], L. L. Coutinho[4], and R. T. Wiedmann[1], [1]*USDA, ARS, U.S. Meat Animal Research Center*, *Clay Center, NE*, [2]*Michigan State University*, *East Lansing*, [3]*USDA, ARS, Bovine Functional Genomics Laboratory*, *Beltsville, MD*, [4]*University of Sao Paulo*, *Brazil*.

The genomes of multicellular eukaryotic organisms encode numerous non-coding RNA (ncRNA) species with a variety of known functions, as well as many whose functions are currently unknown. One class of ncRNA genes produce transcripts that are processed by specific cellular machinery to result in small ~18-22 nucleotide-long micro-RNAs (miRs) that provide a targeting mechanism to direct RNA-protein complexes (RISC) to cognate mRNAs. Association of the RISC complex with mRNA has been shown to control gene expression by inhibiting translation or targeting messenger RNA for degradation. The data on miR expression and activity suggests that a major role for this level of regulation is to provide a mechanism for switching the physiological state of the cell in a rapid fashion, as a single miR may have numerous target genes and may act more rapidly than transcriptional control by silencing mRNA already present in the cell. Tissue-specific miRs have been implicated in control of development, homeostasis, and immune response. Studies in mouse myoblast cell lines have defined significant responses of miR populations during differentiation. Our studies of miR profiles in porcine and bovine satellite cell and fetal muscle samples demonstrate marked similarity, but also significant differences, to the murine system. In addition, miR profiles in fast-growing neonatal muscle and fully mature muscle indicate potential roles for regulation of gene expression throughout the life cycle. Analysis of mRNA coexpression through these developmental stages of muscle growth and maturity begins to provide a picture of the interplay between protein-coding gene expression and regulation at the post-transcriptional level via miRs. The data suggest potentially critical roles for miRs in the switch from proliferation to differentiation, in regulating muscle growth in early life, and in maintaining tissue homeostasis in mature muscle.

Key Words: Muscle Development, Non-coding RNA, Gene Regulation

851 Cellular and molecular regulation of muscle growth and development in meat animals. W. R. Dayton*, M. E. White, and M. R. Hathaway, *University of Minnesota*, *St Paul*.

Insulin-like growth factor (IGF)-I and IGF binding proteins (IGFBP) play a significant role in mediating the actions of myostatin, TGF- β and anabolic steroids on muscle cells at the cellular and molecular level. Both myostatin and TGF-β suppress proliferation in porcine embryonic myogenic cell (PEMC) cultures. Treatment with myostatin or TGF-β also increases production and secretion of IGFBP-3 and IGFBP-5 by PEMC cultures. Immunoneutralization of IGFBP-3 and IGFBP-5 in the culture media of TGF-β or myostatin-treated PEMC cultures returns proliferation rate to 90% of levels observed in control cultures that were not treated with myostatin or TGF-β. Consequently, it appears that IGFBP-3 and IGFBP-5 play a crucial role in mediating the proliferation-suppressing actions of myostatin and TGF-β in PEMC cultures. Furthermore, the mechanisms by which IGFBP-3 and IGFBP-5 facilitate the proliferation-suppressing activity of myostatin and TGF-β appear to be IGF-independent and do not involve reduced phosphorylation of Smad2 or Smad3 by the TGF-β or myostatin receptors. The IGF/IGFBP system also plays a significant role in mediating the muscle-growth-enhancing actions of anabolic steroids. Steers implanted with a combined trenbolone acetate/estradiol (TBA/E) implant have increased circulating IGF-I levels and increased IGF-I mRNA levels in muscle tissue. Treatment of cultured bovine satellite cells (BSC) with E or trenbolone (TB) results in increased levels of IGF-I mRNA in these cells. Additionally, treatment of cultured BSC with either TB or E results in increased proliferation rate. Although, these data suggest that TBA/E-induced increases in muscle IGF-I levels may mediate the enhanced muscle growth observed in feedlot steers implanted with these steroids, studies utilizing the IGF-I receptor blocker JB1 indicate that the proliferation-promoting effects of TB and E in BSC cultures may not result solely from increased IGF-I levels.

Key Words: Muscle, Myostatin, Anabolic Steroid

852 Application of cellular mechanisms to growth and development of food producing animals. B. J. Johnson*, *Kansas State University*, *Manhattan*.

Postnatal skeletal muscle growth is a result of hypertrophy of existing skeletal muscle fibers in food producing animals. Accumulation of additional nuclei, as a source of DNA, to the multinucleated skeletal muscle fiber aids in fiber hypertrophy during periods of rapid skeletal muscle growth. Muscle satellite cells are recognized as the source of nuclei to support muscle hypertrophy. Exogenous growth enhancing compounds have been used to modulate growth rate and efficiency in meat animals for over a half century. In cattle, these compounds enhance efficiency of growth by preferentially stimulating skeletal muscle growth compared to adipose tissue. There are two main classes of compounds approved for use in cattle in the United States: anabolic steroids and β-adrenergic agonists (β-AA). Administration of both trenbolone acetate (TBA) and estradiol (E) as implants increased carcass protein accumulation 8 to 10% in yearling steers. Muscle satellite cells isolated from steers implanted with TBA/E had a shorter lag phase in culture compared to satellite cells isolated from control steers. Collectively, these data indicate that activation, increased proliferation, and subsequent fusion of satellite cells in muscles of implanted cattle may be an important mechanism by which anabolic steroids enhance muscle hypertrophy. Oral administration of β-AA to ruminants does not alter DNA accumulation in skeletal muscle over a typical feeding period. The enhanced muscle hypertrophy observed due to β-AA feeding occurs by direct, receptor-mediated changes in protein synthesis and degradation rates of skeletal muscle tissue. Often, the muscle is unable to sustain this level of hypertrophy due to no additional accumulation of nuclei to support the increased protein accretion. Proper timing of anabolic steroid administration when coupled with β-AA feeding could result in a synergistic response in skeletal muscle growth due to the effects of anabolic steroids at increasing satellite cell activity which then can support the rapid hypertrophic changes of the muscle fiber when exposed to β-AA.

Key Words: Anabolic Steroid, β-Adrenergic Agonist, Skeletal Muscle

International Animal Agriculture - Livestock and Poultry: Global Livestock and Poultry Issues

853 Factors affecting milk price and revenues of dairy farms in the central region of Thailand. J. A. Rhone*[1], R Ward[1], S Koonawootrittriron[2], and M. A. Elzo[1], [1]*Univeristy of Florida*, *Gainesville*, [2]*Kasetsart University*, *Bangkok, Thailand*.

Milk prices in Thailand are based on a base price set by the government as well as premiums and deductions, based on milk quality and components, given by dairy cooperatives. The objectives of this study were 1) to determine month and year, farm location, and farm size effects on milk price, and 2) to calculate farm milk revenues across time, farm location, and farm size. There were a total of 967,110 farm milk yield and 58,575 milk price records from 1034 farms collected from 2003 to 2006. Farm milk revenues were calculated as the product of farm milk yield and milk price. Milk price was analyzed using a linear model. Fixed effects were 1) pricing system (1 = price based on milk fat and bacterial score, and 2 = price based on milk fat, bacterial score, and bulk tank somatic cell count, 2) interaction of pricing system by month nested within year, 3) interaction of pricing system by farm size (number of cows milked per day); small: < 10 cows; medium: 10 to 19 cows; and large: > 20 cows, and farm location (4 districts: Kaeng Khoi, Muaklek, Pak Chong, and Wang Muang). All fixed effects were important ($P < 0.05$) sources of variation for milk price. Milk prices in system 1 were higher (11.54 vs. 11.71 Thai bhat, $P < 0.05$) than in system 2. Under pricing system 1, large farms had the lowest milk price ($P < 0.05$) in all districts except Kaeng Khoi. Under pricing system 2, small farms had higher ($P < 0.05$) milk prices than medium and large farms across all districts. Farms in Kaeng Khoi had the least loss of revenue due to milk price, whereas farms in Wang Muang had the greatest. Higher bacterial scores and (or) bulk tank somatic cell counts in large and medium farms made them lose more revenue than small farms. Improvements in farm management and sanitary conditions would need to be implemented if milk revenues are to be increased.

Key Words: Milk Price, Milk Revenue, Thailand

854 Factors affecting bacterial score and bulk tank somatic cell count of dairy farms in the central region of Thailand. J. A. Rhone*[1], S. Koonawootrittriron[2], and M. A. Elzo[1], [1]*University of Florida*, *Gainesville*, [2]*Kasetsart University*, *Bangkok, Thailand*.

The objectives of the study were to determine the effects of year-season, farm location, and farm size on bacterial score and bulk tank somatic cell count (BTSCC). Collection of data was at the farm level; individual animal records were unavailable. There were a total of 58,575 bacterial score and 24,109 BTSCC count records from 1,034 farms. The BTSCC data was transformed using natural logarithms. The BTSCC and bacterial score traits were analyzed as single trait mixed and log linear models, respectively. Fixed effects were: 1) year-season, where year = 2004 to 2006, and season = winter (November to February), summer (March to June), and rainy (July to October), 2) farm size (number of cows milked per day of farms), small: < 10 cows; medium: 10 to 19 cows; and large: > 20 cows, and 3) farm locations (4 districts: Kaeng Khoi, Muaklek, Pak Chong, and Wang Muang). Random effects were farm and residual effects. Farm effects were assumed to be uncorrelated. Important effects were year-season, farm district by farm size interaction for log bacterial score (LBS), and month nested within year and farm district by farm size interaction for log BTSCC. The 2006 summer was lower ($P < 0.05$) than all other seasons and the rainy season was higher ($P < 0.05$) than either adjacent season for LBS. Small size farms in Muaklek and Pak Chong had lower ($P < 0.05$) LBS values than medium and large farms. There were no differences among farm sizes in Kaeng Khoi and Wang Muang for LBS. Small size farms in Muaklek, Pak Chong, and Wang Muang had lower ($P < 0.05$) log BTSCC values than both medium and large size farms. There was no difference ($P < 0.05$) among farm sizes for log BTSCC in Kaeng Khoi. The lower values of LBS and log BTSCC in most small size farms suggests they had better health and sanitary management than medium and large size farms.

Key Words: Bacterial Score, Bulk Tank Somatic Cell Count, Thailand

855 Effects of supplementing finger millet straw with concentrates differing in partitioning factor on microbial biomass synthesis in crossbred dairy cows. W. Jackson*[1], S. Sudha[2], U. Krishnamoorthy[2], R. Bhaskaran[2], and P. Robinson[1], [1]*University of California*, *Davis*, [2]*Karnataka Veterinary, Animal & Fisheries Sciences University*, *Bangalore, Karnataka, India*.

Improving utilization of crop residues by obtaining maximum microbial biomass from ruminally digestible organic matter (OM) is beneficial to lactating cows. The 'Partitioning Factor' (PF) is an index of distribution of truly degraded substrate between microbial biomass and fermentation waste products as measured by in vitro digestion, where a high PF indicates more efficient microbial biomass synthesis. In this study, effects of supplementing finger millet straw (FMS) with concentrates differing in PF on DM intake, nutrient digestibility and N metabolism were studied in mid-lactation cows. A high PF concentrate (HPFC) and a low PF concentrate (LPFC) were formulated to be iso-metabolizable energy and iso-N, but to differ in PF. Six crossbred cows were divided into 2 groups based on BW in a switchover design consisting of 2 periods of 4 weeks. A 5 day metabolism study was conducted at the end of each period. Diets consisted of ad libitum FMS as the sole source of forage, and concentrate supplements to meet requirements (ARC, 1984). FMS was fed daily at 8:30 h and concentrate was fed in 2 portions at 5:30 h and 14:00 h. The ME (MJ/kg DM) and CP content (g/kg DM) of the HPFC and LPFC concentrates were 12.7, 168 and 13.4, 188, respectively, and the PF was 3.78 and 3.65. Intake (kg/d) of DM, OM and CP for the HPFC and LPFC groups were 12.72, 11.61, 0.54 and 12.40, 11.59 and 0.53, respectively, but they did not differ between treatments. OM digestibility (g/kg DM consumed) of 624 vs. 659, as well as the N retained (8.0 g/d) was also similar. Urinary allantoin excretion (UAe, mmol/d) in HPFC was higher (P=0.05) than in LPFC (170 vs. 131), but calculated microbial N supply to the duodenum was similar between groups (125 and 112 g/d). Total N content (g/d) in urine was higher (P=0.0003) in the HPFC (57.0) vs. the LPFC (43.0) group, and BW gain (g/d) for the groups was 320 and 30 (P=0.09). A concentrate with a higher PF tended to have a higher efficiency of microbial biomass synthesis in an FMS based high forage diet.

Key Words: Efficiency of Microbial Biomass Synthesis, Allantoin, Microbial Nitrogen

Nonruminant Nutrition: General Topics

856 Temporal changes in biochemical indices of sulfur amino acid (SAA) metabolism in the folate deficient piglet. Z. Zhang* and J. D. House, *University of Manitoba*, *Winnipeg, MB, Canada*.

The impact of folate deficiency on temporal changes in markers of SAA metabolism was determined in weanling pigs. Pigs (5.3 kg; n=6/treatment) were fed a basal semi-purified diet (20.5% casein; 3474 kcal ME/kg) containing either 0 (folate deficiency, FD) or 0.6 (folate control, FC) mg/kg folate, using a pair-feeding design. Feed intake was measured daily, and body weight and plasma were collected weekly for 6 weeks. Animals were killed at the end of 6 weeks, and tissue samples harvested. Plasma folate and vitamin B-12 were determined by Quantaphase ? Folate/B12 Radioassay. Total homocysteine (Hcy) and cysteine (Cys) were quantified by reverse-phase HPLC. Hepatic serine hydroxymethyltransferase (SHMT) was measured by a binding assay using radioactive isotope L-[^{14}C(U)]-Serine. SHMT was statistically analyzed by PROC GLM with randomized complete block design. The mixed model was applied to analyze all the other parameters with repeated observations. In addition to average daily feed intake, average daily gain and feed efficiency were not affected by folate deficiency throughout the experiment. Plasma folate in FD pigs was decreased from the end of the second week (FC=72.7 nM; FD=29.1 nM; SE=8.4; p<0.001) till the sixth week (FC=67.2 nM; FD=15.1 nM; SE=9.1; p<0.001). Plasma vitamin B-12 in FD pigs tended to increase over the depletion. At 6 weeks, plasma vitamin B-12 was significantly elevated by folate deficiency (FC=229 pM; FD=1074 pM; SE =198; p<0.01). Increases in plasma Hcy in FD pigs were detected on the fifth (FC=16.6 μM; FD=37.0 μM; SE=5.9; p<0.05) and the sixth (FC=16.6 μM; FD=71.3 μM; SE=5.9; p<0.0001) weeks. By contrast, decreases in plasma Cys in FD pigs were found on the fifth (FC=187.0 μM; FD=146.5 μM; SE=9.3; p<0.01) and the sixth (FC=226.6 μM; FD=159.6 μM; SE=5.9; p<0.0001) weeks. SHMT was not affected by folate deficiency (p>0.05). These results provide evidence that folate depletion perturbs vitamin B-12 and SAA metabolism in the young pig.

Key Words: Folate, Homocysteine, Pig

857 Effects of diet conditioning (steam at low and high temperatures, expanding, and extruding) prior to pelleting on growth performance in nursery pigs. K. K. Lundblad*[1,2], S. Issa[2], J.D. Hancock[2], M. Sørensen[3,4], K. C. Behnke[2], E. Prestløkken[1], L. J. McKinney[2], and S. Alavi[2], [1]*Felleskjøpet Fôrutvikling*, *Trondheim, Norway*, [2]*Kansas State University*, *Manhattan*, [3]*University of Life Sciences*, *Aas, Norway*, [4]*AKVAFORSK*, *Aas, Norway*.

A total of 180 weanling pigs (avg BW of 5.6 kg) was used in a 36-d experiment to determine the effects of diet conditioning on growth performance. The diets were wheat-fishmeal-soybean meal-based and formulated to 1.6% lysine for d 0 to 13 and 1.35% lysine for d 13 to 36. Treatments were: 1) a control diet fed in mash form; 2) low-temperature steam conditioning (50°C for 20 sec before pelleting); 3) high-temperature steam conditioning (90°C for 20 s before pelleting); 4) expander conditioning (75°C for approximately 20 s in a preconditioner and 105°C for 20 s in the expander barrel before pelleting); and 5) extrusion processing (92°C for 150 s in a preconditioner and 120°C for approximately 50 s in the extruder barrel). The diets were fed to six pigs/pen and six pens/treatment with feed and water consumed on an ad libitum basis. For d 0 to 13, G:F of pigs fed the hydro-thermally processed treatments was greater than for pigs fed the mash control (P< 0.01) and ADG was greater for pigs fed diets that were extruder vs expander conditioned (P<0.06). Overall (d 0 to 36), ADG was not different among pigs fed the dietary treatments (P>0.40). However, G:F was greater for pigs fed hydro-thermally processed diets vs the mash control (P<0.01) and for pigs fed extruder vs expander conditioned diets (P<0.03). Means for pigs fed the dietary treatments (1 to 5 as stated above) were 287, 289, 288, 287, and 328 g/d for d 0 to 13 ADG and 945, 1,038, 1,104, 1,067, and 1,169 g/kg for d 0 to 13 G:F, respectively. Overall means were 425, 439, 429, 430, and 445 g/d for ADG and 760, 810, 802, 802, and 860 g/kg for G:F, respectively. In conclusion, hydro-thermal processing (and especially extrusion) of diets improved growth performance of weanling pigs.

Key Words: Pelleting, Expanding/Extrusion, Pig

858 Effects of diet conditioning (steam at low and high temperatures, expanding, and extruding) prior to pelleting on growth performance in broiler chicks. K. K. Lundblad*[1,2], S. Issa[2], J. D. Hancock[2], M. Sørensen[3,4], K. C. Behnke[2], E. Prestløkken[1], L. J. McKinney[2], and S. Alavi[2], [1]*Felleskjøpet Fôrutvikling*, *Trondheim, Norway*, [2]*Kansas State University*, *Manhattan*, [3]*University of Life Sciences*, *Aas, Norway*, [4]*AKVAFORSK*, *Aas, Norway*.

A total of 150 broiler chicks (1 d old and average BW of 41 g) was used in a 21-d experiment to determine the effects of diet conditioning on growth performance. The diets were wheat-fishmeal-soybean meal-based and formulated to 1.35% lysine. Treatments were: 1) a control diet fed in mash form; 2) low-temperature steam conditioning (50°C for 20 sec before pelleting); 3) high-temperature steam conditioning (90°C for 20 s before pelleting); 4) expander conditioning (75°C for approximately 20 s in a preconditioner and 105°C for 20 s in the expander barrel before pelleting); and 5) extrusion processing (92°C for 150 s in a preconditioner and 120°C for approximately 50 s in the extruder barrel). The diets were fed to five chicks/cage and six cages/treatment with feed and water consumed on an ad libitum basis. Average daily gain (ADG) and average daily feed intake (ADFI) were greater for chicks fed diets that were simply steam conditioned vs expander and extruder conditioned. Also, expander conditioning resulted in greater ADG and ADFI than extruder conditioning (P<0.004). Gain to feed ratio (G:F) was not different among chicks fed the various treatments (P>0.21). Means for chicks fed the dietary treatments (1 to 5 as stated above) were 32, 34, 37, 32, and 28 g/d for ADG, 47, 47, 52, 47, and 38 g/d for ADFI, and 681, 723, 712, 681, and 737 g/kg for G:F. In conclusion, there was no advantage to using elaborate conditioning technologies (expanding and extrusion) vs. steam conditioning prior to pelleting diets for broiler chicks.

Key Words: Pelleting, Expanding/Extrusion, Chicks

859 Effects of feed form and fiber inclusion in the diet on nutrient utilization in twenty one–day–old broilers. E. Jiménez-Moreno[1], J. M. González-Alvarado[1,2], A. de Coca-Sinova[1], R. Lázaro[1], and G. G. Mateos*[1], [1]*Universidad Politécnica de Madrid*, *Spain*, [2]*Universidad Autónoma de Tlaxcala*, *México*.

We evaluated the effects of feed form and the inclusion of fiber in the diet on total tract apparent retention of nutrients (TTAR) and AME_n of diets in 21–d–old chicks fed low–fiber diets. The experimental design was completely at random with twelve treatments arranged factorially with two feed forms (mash and pelleted) and six diets that consisted in a combination of three sources of fiber (OH; oat hulls, RH; rice hulls, and SFH; sunflower hulls) and two levels of fiber source inclusion (2.5 and 5%). In addition, a control diet based on rice (57.7%), soy protein concentrate (24%), fish meal (7.6%), fat (5.05%), and celite (2%) that contained 3,200 kcal AME_n /kg, 1.4% total lysine, and 1.6% crude fiber was formulated and offered either in mash or pellet form. The diameter of the pellet was 2–mm. The fiber source was included (wt/wt) at expenses of the whole diet. Each treatment was replicated six times (12 chicks caged together). At 21 d of age TTAR of DM, organic matter (OM), soluble ash, and nitrogen (N), and AME_n of the diets were determined. Fiber inclusion increased TTAR of all dietary components studied ($P \leq 0.001$). However, pelleting of the diet did not improve digestibility of any dietary component ($P \geq 0.10$). Chicks fed SFH had lower TTAR of DM, OM, and N than chicks fed OH, with chicks fed RH intermediate ($P \leq 0.05$). The TTAR of soluble ash was greater with SFH than with RH ($P \leq 0.01$). An interaction fiber source x level of fiber inclusion in the diet was observed for TTAR of DM ($P \leq 0.05$) and AME_n ($P \leq 0.001$); an increase in RH from 2.5 to 5% decreased TTAR of DM and AMEn, but no effect was observed with OH or SFH. We conclude that feed form has not effect on digestibility but that the inclusion of a fiber sources improves utilization of nutrients. Therefore, young broilers fed low–fiber diets might benefit with the inclusion of additional fiber in the diet.

Key Words: Pellet, Hulls, Nutrient Digestibility

860 Effects of inclusion of several fiber sources on digesta pH of broilers. E. Jiménez-Moreno*[1], J. M. González-Alvarado[1,2], A. González-Serrano[1], R. Lázaro[1], and G. G. Mateos[1], [1]*Universidad Politécnica de Madrid*, *Spain*, [2]*Universidad Autónoma de Tlaxcala*, *México*.

A trial was conducted to evaluate the effect of the inclusion of 3% of a fiber source in the diet on pH of the digesta in the gastrointestinal tract (GIT). The experimental design was completely at random with four dietary treatments. The control diet contained 58% rice, 7% fish meal, 22% soy protein concentrate, and 3% sepiolite, and contained 3,095 kcal AME_n/kg, 1.31% total lysine and, 1.53% crude fiber. The three additional experimental diets were similar to the control diet but

sepiolite was substituted (wt/wt) by oat hulls (OH; insoluble and high in lignin fiber source), sugar beet pulp (SBP; soluble and low in lignin fiber source), or microcrystalline cellulose (CEL; insoluble fiber source with no lignin). Each treatment was replicated five times (1 chick per cage). The mean particle size of the diets was 472, 567, 771, and 682 µm for control, CEL, OH, and SBP diets, respectively. The pH of the crop, proventriculus, gizzard, duodenum, jejunum, ileum, ceca, and rectum digesta was recorded at 25 d of age. Fiber inclusion modified the pH of all the organs and segments of the GIT but the effects varied with the GIT segment considered and the fiber source used ($P \leq 0.05$). Inclusion of OH reduced pH of gizzard digesta but not crop or proventriculus pH. Inclusion of SBP increased pH of crop digesta but reduced proventriculus and gizzard pH. The inclusion of CEL had little influence on digesta pH of proximal GIT (from crop to gizzard). Also, the inclusion of fiber had little effect on pH of distal GIT (beyond the gizzard). The only effect of interest observed was that SBP tended to increase the pH in this part of the GIT whereas CEL inclusion had the opposite effect. We conclude that the inclusion of OH or SBP in low–fiber diet for broilers reduces digesta pH in the gizzard but that CEL had no effect. Therefore, the inclusion of OH or SBP to low–fiber diet might improve motility and health of the GIT.

Key Words: Digesta pH, Fibers Sources, Broiler

861 Adhesion ability of probiotic lactobacillus strains and their effect on piglet performance. S. Qiao*, X. Li, and H. Yu, *National Key Lab of Animal Nutrition, China Agricultural University*, *Beijing, China*.

Four Lactobacillus strains, Lactobacillus gasseri S1031, Lactobacillus reuteri I2021, Lactobacillus acidophilus I021 and Lactobacillus fermentum I5007 were isolated from mucosa of stomach, duodenum, jejunum and colon, respectively, of healthy weaning pigs and screened by in vitro selection from over 7000 native Lactobacilli colonoes according to probiotic bacteria criteria including resistance to heat, low pH, copper and bile salts in addition to antagonism to pathogenic agents. A complex Lactobacilli preparation made of the four Lactobacillus strains with approximately 2.0 X 108 CFU per ml was fed to 36 piglets weaded at 28±2 d (7.65 ± 1.09 kg BW). The piglets fed complex Lactobacilli preparation showed better ADG (P<0.05) than that fed carbadox. Earlier studies have shown that adhesion is a prerequisite for the colonization of bacteria and strains with the highest adhesion ability have the greatest effect on the health and performance of the host. Therefore, the adhesion ability of the four Lactobacillus strains on Caco-2 cells was observed by light and electron microscope, and that on the porcine intestinal mucus was examined by the scintillation counter using [methyl-3H] thymidine labeled bacteria. Lactobacillus fermentum I5007 displayed the best adhesion ability among the four strains. In competitive exclusion assay using Salm. typhimurium and E. coli K88ac, Lactobacillus fermentum I5007 showed an excellent probiotic ability. Futhermore, 288 piglets weaned at 28±2 d (7.65 ± 1.09 kg BW) were uesd to compare the effects of Lactobacillus fermentum I5007 preparation and complex Lactobacilli preparation on the piglet performance. The complex Lactobacilli preparation was prepared using the four lactobacillus strains with approximately 2.0 X 108 CFU per ml. While, Lactobacillus fermentum I5007 preparation was prepared with approximately 2.0 X 108 CFU per ml. The piglets fed Lactobacillus fermentum I5007 preparation showed better ADG (P<0.05) than that fed the complex Lactobacilli preparation.

Key Words: Lactobacillus, Probiotic, Adhesion Ability

862 Supplementing rice protein concentrate to a milk-based diet enhances growth performance in weaned pigs. Z. P. Hou[1], Y. L. Yin*[1,2], R. L. Huang[1], T. J. Li[1], P. Zhang[1], X. Wu[1], and G. Y. Wu[1,3], [1]*Key Laboratory of Subtropical Agro-ecology, Institute of Subtropical Agriculture, The Chinese Academy of Sciences*, *Changsha, Hunan, China*, [2]*Nanchang University*, *Nanchang, Jiangxi, China*, [3]*Texas A&M University*, *College Station*.

Milk products, including dried skim milk and dried whey, are typical feed ingredients for young pigs because of their high palatability and digestibility values. However, these protein sources are currently expensive and, therefore, their use is limited. The objective of this study was to determine whether rice protein concentrate (RPC) can replace milk protein without affecting piglet growth performance. The basal milk replacer powder used in the present study consisted of 60% dried whey, 26% skimmed milk, 6.2% a-casein, 3.6% lactose, 1.65% glucose, 1% calcium lactate, 1% dihydrocalcium phosphate, 0.1% vitamin premix, 0.2% mineral premix, 0.1% lysine, 0.1% methionine, and 0.05% antibiotic. Forty-four piglets weaned at 7 d of age (BW 2.83±0.22 kg) were assigned randomly to one of the four treatments, representing the substitution of 0 (control), 5, 10, and 15% dried whey with RPC in milk replacer powder. Piglets had free access to their respective diets for 3 wk. The results indicate that there was no difference (P<0.05) in ADG, ADFI or feed/gain ratio among the treatment groups in wks 1 and 2. During wk 3, feed intake and ADG by piglets fed the 10% RPC diet were 13% and 22% higher (P<0.05), respectively, than those for control piglets, whereas growth performance did not differ (P>0.05) between piglets fed the 5 and 10% RPC diets. Growth performance of piglets fed the 15% RPC diet tended to be lower than that of piglets fed the 10% RPC diet (P>0.05). These results indicate that an optimal replacement of 10% dried whey with RCP in the diet for weaned piglets did not compromise their growth performance.

Key Words: Weaned Pigs, Rice Protein Concentrate, Piglet Growth

863 Effects of different carbohydrates on the growth performance of weaned pigs. X. G. He*[1,2], H. J. Xu[1,2], X. F. Kong[1,2], W. Y. Chu[2], R. L. Huang[2], Z. Y. Deng[1], S. W. Kim[3,4], G. Y. Wu[1,4], and Y. L. Yin[1,4], [1]*Nanchang University*, *Nanchang, Jiangxi, China*, [2]*Institute of Subtropical Agriculture, The Chinese Academy of Sciences*, *Hunan, Changsha, China*, [3]*Texas Tech University*, *Lubbock*, [4]*Texas A&M University*, *College Station*.

This experiment was conducted to evaluate the effects of different carbohydrates on the growth performance of weaned pigs, with the goal of choosing appropriate carbohydrates to formulate diets for weaned piglets. One hundred twenty Duroc x Landrace x Yorkshire pigs weaned at 28 d of age were randomly assigned to one of the five treatments (24 pigs/treatment), representing supplementation with 6% corn (control), lactose, sucrose, glucose, or cornstarch to a maize-soybean meal-based diet. Pigs had free access to their respective diets and drinking water. At the end of a 28-d experimental period, blood samples were collected from pigs before they were euthanized to obtain the duodenum and jejunum. The results indicate that the ADG of pigs fed the glucose diet was higher (P<0.05) than that for the sucrose group. The feed:gain ratio of pigs fed the lactose group was lower (P<0.05) than that for the other four groups. The activities of lactase in the duodenum and jejunum of pigs fed the lactose diet were higher (P<0.05) than that for the control, sucrose, glucose, and cornstarch groups. Intestinal maltase activities in the lactose and

cornstarch groups were similar (P>0.05) but were higher (P<0.05) than those for the other 3 groups of piglets. Intestinal sucrase activities in the control, sucrose and cornstarch groups were higher (P < 0.05) than those for the glucose and lactose groups. Serum concentrations of glucose and calcium were higher (P<0.05) in the sucrose group than that in the cornstarch group. In conclusion, glucose could be used to substitute lactose completely or partly in the diet for weaned pigs but sucrose or cornstarch cannot be used effectively as a single source of carbohydrate.

Key Words: Carbohydrate, Weaned Pigs, GrowthPerformance

864 *Pediococcus pentosaceus* FBB61 reduces oxidative damage by ochratoxin A in rats. A. Piva[1], V. Pizzamiglio*[1], E. Grilli[1], M. R. Messina[1], P. P. Gatta[1], G. Casadei[2], M. Bognanno[3], and F. Galvano[3], [1]*DIMORFIPA, University of Bologna*, *Bologna, Italy*, [2]*Northeastern University*, *Boston, MA*, [3]*STAFA Department, Mediterranean University of Reggio Calabria*, *Reggio Calabria, Italy*.

Ochratoxin A carcinogenicity and cytotoxicity are associated with free radical mediated oxidative cell damage. Aim of the present study was to investigate the effects of a chronic in-feed supplementation of *Pediococcus pentosaceus* FBB61 to counteract the toxic effects induced by chronic exposure to ochratoxin A contaminated diet in rats. Sprague Dawley male rats (initial body weight 83.9±8.2 g) were divided in 4 dietary treatments (10 animals/group, individually housed) fed a commercial standard pellet diet (control, CTRL) supplemented with *P. pentosaceus* FBB61 (10^6 CFU/g of feed, PP) or ochratoxin A (200 ppb, OTA) or both the previous treatments (PP+OTA). After 4 weeks rats were sacrificed by an over-dose of ether. Liver, kidneys and brain of each rat were rapidly removed, plasma samples were collected and immediately frozen (-80 °C). Aliquots of tissue homogenate were used to evaluate non-proteic thiol groups (RSH) and lipid hydroperoxide (LOOH) levels, as markers of oxidative damage. Data were analyzed with one-way ANOVA. No differences (P > 0.05) were observed in growth performance. PP-fed rats showed higher (P < 0.001) RSH value in liver and brain and lower (P < 0.001) LOOH values in liver and kidney than all other treatments. PP-fed rats improve oxidative status of liver than control group. Higher levels of RSH and lower levels of LOOH in liver of PP+OTA-fed rats than of OTA-fed rats suggest that supplementation of PP was able to reduce OTA induced oxidative damage.

Table 1.

	CTRL	SD	PP	SD	OTA	SD	PP+OTA	SD
RSH (nmol/mg of protein)								
Liver	111.9	2.2^c	129.6	3.8^d	74.2	2.2^a	94.4	0.9^b
Kidney	106.8	2.1^c	109.4	4.3^c	85.2	2.6^a	102.8	2.2^b
Brain	88.7	1.8^b	90.8	2.5^c	82.9	1.7^a	84.8	2.5^a
LOOH (µmol/mg of protein)								
Liver	0.34	0.01^b	0.29	0.01^a	0.54	0.01^d	0.37	0.01^c
Kidney	0.34	0.01^b	0.33	0.01^a	0.51	0.02^d	0.39	0.01^c
Brain	0.24	0.01^a	0.24	0.01^a	0.52	0.01^c	0.32	0.01^b

CTRL: standard diet; PP: *P. pentosaceus* FBB61; OTA: ochratoxin A; PP+OTA: both PP and OTA; SD: standard deviation. n=10 Different letters in row indicate P< 0.05

Key Words: Ochratoxin A, Rats, *Pediococcus pentosaceus* FBB61

865 Apparent ileal digestibility of nitrogen, amino acids and energy of soybean meals from different origins in twenty one-day-old broilers. A. Coca-Sinova, D. G. Valencia, E. Jiménez-Moreno, J. M. González-Alvarado, R. Lázaro, and G. G. Mateos*, *Universidad Politécnica de Madrid*, *Spain*.

An experiment was conducted to compare the apparent ileal digestibility (AID) of nitrogen (N), amino acids (AA), and energy (E) of five different soybean meals (SBM) in 21 d old broiler chicks. Four of the SBM samples were collected from local traders, and had a chemical composition within the range accepted by the feed compound industry. Three of them were from Brazil (45.2 to 47.2% CP) and the other was from Argentina (46.1% CP). The fifth batch of SBM was obtained from Owensboro crushing plant (KY, USA). It was a high protein SBM (48.8% CP) obtained after dehulling by using a proprietary processing method (SoyMAX tradermark) that reduced to a minimum the trypsin inhibitors content of the meal, without damaging AA digestibility. The experimental design was completely randomized with 5 treatments and 6 replicates (6 chicks each) per treatment. The experimental diets were based on sucrose, corn starch, and oil and the only source of protein was the SBM tested. All the diets contained approximately 3,100 kcal ME/kg, 20% CP, and 1.24% total lysine. Celite (2%) was included in the diets as an additional source of acid–insoluble ash. All chicks were fed a commercial diet from 1 to 16 d of age and then their respective experimental diets from 17 to 21 d of age. At 21 d of age, digesta was collected from the distal ileum (2 cm anterior to the ileocaecal junction) and N, AA, and E digestibilities were determined. Treatment means were compared using a protected t–test. SoyMAX inclusion increased AID of DM, N, Met, and Cys ($P \leq 0.001$), as compared to the average of the remaining SBM samples. The AIDE was higher for the diet with SoyMAX than for the average of the remaining diets (3,156 vs. 3,012; $P \leq 0.001$). We conclude that SoyMAX had higher N, AA, and E digestibility than the commercial batches of South American SBM tested. Therefore, the inclusion of SoyMAX in prestarter diets might benefit poultry efficiency.

Key Words: Ileal Digestibility, Amino Acids, Soybean Meal Origin

866 Fecal near-infrared reflectance spectroscopy (NIRS) calibrations for predicting intake of donkeys. N. Kidane*, J. Stuth, and D. Tolleson, *Texas A&M University*, *College Station*.

Fecal-near infrared reflectance (fecal-NIRS) has been used as a method for predicting of DMI, and organic matter intake (OMI) of ruminants. Information about the capability of NIRS method for predicting intake of equines (donkeys) is lacking. The objective of the study was to determine the potential of fecal-NIRS calibration for predicting the DMI and OMI of donkeys. One hundred diet-fecal pair samples were generated from in vivo feeding trials conducted for 10 weeks (plus 1 wk adaptation) in the Horse Center, at Texas A & M University. Ten female donkeys (Equus asinus), with an average body weight of 196.3±50.6 kg, were fed 100 different diets blended from 13 natural forage and crop residues. Donkeys were fed twice a day (0700-1900 hr), and daily feed intake, refusal, and fecal output were measured for each diet. Ground fecal samples were scanned in reflectance mode (400-2500 nm) using a Pacific Scientific model 6500 monochromator. Calibrations were developed using modified partial least square regression (MPL) model. The SE of calibration (SEC) for the DMI and OMI were 3.45 g/kgw$^{0.75}$ and 3.21 g/kgw $^{0.75}$, with R^2 values of 0.89, and 0.84, respectively. Independent sample set (n=50) was used to validate the performance of each equation. The SE of prediction

for DMI and OMI were 4.36 g/kgw$^{0.75}$ and 3.28 g/kgw$^{0.75}$ with corresponding r^2 values of 0.84 and 0.87, respectively. Both calibration and validation results indicated that NIRS equations were successfully developed, and could be a used as a tool for predicting the intake of donkeys.

Key Words: Intake, Near Infrared Reflectance spectroscopy, Equine

Nonruminant Nutrition: Natural Phytobiotics for Health of Young Animals: Applications and Mechanisms

867 Natural phytobiotics for health of young piglets and poultry: Mechanisms and application. W. Windisch*[1] and A. Kroismayr[2], [1]*University of Natural Ressources and Applied Life Sciences*, *Vienna, Austria*, [2]*BIOMIN GmbH*, *Herzogenburg, Austria*.

In order to establish alternatives to antibiotic growth promoters (AGPs), phytogenic substances, especially essential oils, are of increasing interest actually. Herbs, spices, plant extracts and essential oils may have positive effects on performance of animals. For example, phytogenic substances derived from Oregano (Origanum vulgare), especially the major active substances thymol and carvacrol, are known to exert antimicrobial and bactericidal actions in vitro. Phytogenic substances can also lead to higher secretion of digestive enzymes and mucus, thus presumably stimulating transport rates of nutrients from intestinal lumen towards blood. As an additional effect phytogenic substances may protect intestinal tissue from microbial attack. In order to gather more information about mode of action of phytogenic feed additives, especially with respect to similarity to AGPs, a commercial essential oils bled was tested with a negative control group as well as a standard AGP (Avilamycin) in a 50days model study employing 120 weaner piglets. A subgroup of 3 x 12 animals was sacrificed at trial day 22 to collect chyme and tissue samples for analysis of chyme microbiology including microbial products, gut morphology, and mRNA expression of apoptotic and inflammatory markers in gut tissues. The study showed that the impact of essential oils on performance and aforementioned parameters was very similar to those of the antibiotic growth promoter (Avilamycin). Essential oils enhanced immune status of piglets and improved nutrient digestibility. Generally speaking, phytogenic feed additives can be considered to act similarly to other substances with growth promoting action (e.g. antibiotics, probiotics, organic acids) with the overall effect of promoted zootechnical performance.

Key Words: Phytobiotics, Essential Oils, Piglets

868 The use of bioactive herbal saccharides in China. X. Piao*[1], S. Yuan[1], S. W. Kim[2], D. Li[1], and D. Ou[1], [1]*China Agriculture University*, *Beijing, China*, [2]*Texas Tech University*, *Lubbock*.

Immune disorders are common phenomena in human and animals due to immature immune system and stress, and thus they might be more susceptible to infection when exposed to a variety of micro-organisms. Bioactive saccharides like polysaccharide and/or oligosaccharide found in herbs are considered to be important components playing roles in immunomodulatory action and antioxidant activity. The structure and bio-activity of saccharides is, however, not fully understood. In this review, immune and antioxidant activities of the saccharides from Chinese herbs are introduced, including polysaccharids (astragalus, ganoderma lucidum, phoma herbarum, lycium barbarum, lentinus edodes, angelica Sinensis, coriolus versicolor, misgurnus anguillicaudatus, spirulina platensis, cladonia furcata, pumpkin polysaccharide) and oligosaccharide (mannan-, galacto-mannan-, isomalto-, fructo-, and xylo-oligosaccharide). Growing interests in herbal saccharides mainly arise from the emerging knowledge about their roles in: 1) enhancing T-cell mediated immune response and humoral immune response; 2) inhibiting the growth of tumour; 3) scavenging effects on active oxygen; 4) protective effects on the acute hepatic injury; 5) promoting wound healing and proliferation of endothelial cells in vitro; 6) decreasing total cholesterol and triglyceride; and 7) improving the impaired glucose tolerance. Considering these possible benefits but without drug residues and low side effects, the bioactive herbal saccharides can be a potential immunmodulating agent to improve health and immune function for life.

Key Words: Saccharide, Immunity, Antioxidant

869 Effect of a phytogenic feed additive on reproduction performance of sows. A. Kroismayr*[1,4], C. Hsun[2], M. Racousier[3], and T. Steiner[4], [1]*University of Natural Resources and Applied Life Sciences*, *Vienna, Austria*, [2]*BIOMIN America Inc*, *San Antonio, Texas*, [3]*Universidad Mayor*, *Santiago, Chile*, [4]*BIOMIN GmbH*, *Herzogenburg, Austria*.

Growing concern about antibiotic growth promoters in animal nutrition has created efforts to use different plant compounds as possible natural alternatives. Phytogenics are a heterogeneous group of feed additives originating from fruits, herbs, spices or other plants. The aim of this study was to evaluate the effect of a defined phytogenic feed additive (Biomin® P.E.P. 1000), which contains essential oils derived from oregano, anise and citrus peels, on reproductive performance of sows. A feeding trial was conducted under guidance of Universidad Mayor, Santiago, Chile. In this study, eighty cross-bred (PIC 337× Camborough 22) sows were assigned to two dietary treatments with 40 sows per treatment. A gestation diet was fed restrictively (3 kg/d) from day 15 to day 3 before farrowing. Subsequently, a lactation diet was offered ad libitum until weaning. Diets based on corn, soybean meal and wheat by-products were either supplemented or not supplemented (Control) with a phytogenic feed additive (Biomin® P.E.P. 1000, 2 kg/t). Addition of phytogenics to the diets substantially increased feed intake in the lactation period. The average feed intake in lactation amounted to 7.070 and 7.238 kg ($P>0.05$) for the control and trial group, respectively. It is generally accepted that a higher feed intake in lactation together with improved digestion results in an increased supply of nutrients and energy for the piglets in the milk. Inclusion of phytogenics in diets of sows positively affected litter performance as well. Compared to the control group, phytogenics improved growth performance of piglets, resulting in higher body weights of piglets at weaning (6.15 vs. 5.90 kg, $P>0.05$). Average daily gain was 220 and 230 g ($P>0.05$) in the control and trial group, respectively. Compared to the control group, piglets in the trial group were 4 and 6% heavier at birth (15.52 vs. 14.93 kg, $P>0.05$) and weaning (65.81 vs. 61.83, $P>0.05$), respectively.

Key Words: Sows, Phytogenics, Essential Oils

870 Effects of phytobiotics on nursery pig performance. R. C. Sulabo*[1], J. Y. Jacela[1], J. M. DeRouchey[1], M. D. Tokach[1], F. Neher[2], R. D. Goodband[1], S. S. Dritz[1], and J. L. Nelssen[1], [1]*Kansas State University*, *Manhattan*, [2]*Biomin Inc.*, *San Antonio, TX*.

A total of 192 weanling pigs (initially weighing 5.85 kg and 22 ± 2 d of age, PIC) were used in a 42-d growth assay to determine the effects of phytobiotics (Biomin® P.E.P. 125 and 125T) on post-weaning growth performance. Pigs were blocked by initial weight and randomly allotted to one of four treatments: 1) negative control (feed containing no antibiotic or phytobiotic); 2) negative control + phytobiotic 1 (125 g/ton of Biomin® P.E.P. 125); 2) negative control + phytobiotic 2 (125 g/ton of Biomin® P.E.P. 125T), and 4) positive control (feed containing 140 g/ton of neomycin sulfate and 140 g/ton of oxytetracycline HCl; Neo/OTC). Each treatment had six pigs per pen and eight replications (pens). Phase 1 and 2 diets were fed from d 0 to 14 and d 14 to 42, respectively. Overall (d 0 to 42), ADG (g), ADFI (g), and G:F was 453, 642, and 0.71 for pigs fed the negative control; 481, 658, and 0.73 for pigs fed phytobiotic 1; 477, 649, and 0.74 for pigs fed phytobiotic 2; and 502, 705, and 0.71 for pigs fed the positive control. Pigs fed Neo/OTC had greater (P<0.03) ADG and ADFI than pigs fed the negative control diet and pigs fed diets with phytobiotics. Addition of phytobiotics to the nursery diet also increased (P<0.03) ADG and G:F compared to pigs fed diets without antibiotics and improved (P<0.01) G:F compared to pigs fed the positive control diet. No differences (P>0.38) were observed in ADFI between pigs fed the negative control diet and pigs fed either phytobiotic. Pigs fed diets with Neo/OTC had similar (P>0.28) G:F compared to pigs fed diets without antibiotics. No differences (P>0.52) were observed in ADG, ADFI, and G:F between pigs fed diets with phytobiotic 1 and 2. In conclusion, phytobiotics in nursery diets improved post-weaning growth performance when added to diets without antibiotics. Further research is needed to elucidate specific modes of action that caused positive effects in post-weaning growth and efficiency.

Key Words: Phytobiotics, Antibiotics, Nursery Pig

871 Dietary supplementation with *Acanthopanax Senticosus* extracts enhances the digestion and absorption of dietary protein and amino acids in weaned pigs. F. G. Yin*[1], X. F. Kong[1], Y. L. Yin[1], H. J. Liu[1], F. F. Xing[1], Q. H. He[1], T. J. Li[1], R. L. Huang[1], P. Zhang[1], and G. Y. Wu[1,2], [1]*Institute of Subtropical Agriculture, The Chinese Academy of Sciences*, *Changsha, Hunan, China*, [2]*Texas A&M University*, *College Station*.

This study was conducted to determine the effects of dietary supplementation with *Acanthopanax senticosus* extracts (ASE) on the digestion and absorption of protein and amino acids in weaned pigs. Sixty piglets weaned at 21 d of age were randomly assigned to one of the three treatment groups, representing supplementation with 0 (control) or 0.1% ASE or 0.02% colistin (an antibiotic) to a corn- and soybean meal-based diets for 28 d (n=20 pigs/group). On d 0, 7, 14 and 28 post the initiation of ASE supplementation, venous blood samples were obtained from 5 pigs per group and sera were analyzed for amino acids. On d 28, pigs were euthanized to obtain digesta from the terminal ileum for determining total amino acids. The results indicated that serum concentrations of total amino acids in all groups of pigs were gradually increased (P<0.05) with increasing age. On d 28, serum concentrations of His and Lys in ASE-supplemented pigs were higher (P<0.05) than those in the other two groups, whereas serum concentrations of Thr in ASE-supplemented pigs were higher (P<0.05) than those in colistin-supplemented pigs. Serum concentrations of Phe, Tyr, Leu, Ile and Ala in ASE-supplemented pigs were higher (P<0.05) than those in the control group. Concentrations of Phe, Tyr, Leu, Ile, Ala, Gly, Asp, Glu, His, Lys and Ser in the digesta of in ASE-supplemented pigs were lower (P<0.05) than those in the other two groups. Further, concentrations of Val, Arg and Thr Ser were lower (P<0.05) in ASE-supplemented pigs than those in colistin-treated pigs. Collectively, these findings suggest that dietary supplementation with ASE enhances the digestion and absorption of protein or amino acids in weaned pigs.

Key Words: Herbal Extracts, Amino Acids, Weaned Pigs

Nonruminant Nutrition: Weanling Pig Nutrition

872 Effect of organic acids and antibiotic growth promoters on growth performance, gastrointestinal pH, intestinal microbial populations and immune responses of weaned pigs. Z. Li[1], D. Li[1], G. Yi*[2], J. Yin[1], and P. Sun[1], [1]*China Agricultural University*, *Beijing, P.R. China*, [2]*DaChan NorthEast Asia Corp*, *Beijing, P. R. China*.

Two experiments compared the effects of feeding organic acids and antibiotic growth promoters (AGP) in weaned pigs. Nursery pigs (N=96, 7.80 ± 0.07 kg) were allotted to a control or supplemented with AGP (200 ppm chlortetracycline plus 60 ppm Lincospectin), 0.5% potassium diformate, or 0.5% dry organic acid blend ACTIVATE Starter DA. During 4 weeks postweaning, pigs fed AGP or ACTIVATE had better ADG (P<0.03) and GF (P<0.04) than controls. On d 14 postweaning, control pigs had the lowest fecal lactobacilli counts among all treatments (P<0.02), whereas pigs fed AGP or ACTIVATE tended to have lower fecal E. coli counts compared to the controls (P<0.08). Serum IGF-1 levels of pigs fed AGP was greater than control pigs (P<0.03). Weaned pigs (N=24, 5.94 ± 0.33 kg) were used to evaluate AGP and ACTIVATE on performance, gastrointestinal measurements, and immune response of E. coli K88+ challenged pigs. Pigs were fed a control, or supplemented with AGP (100 ppm colistin sulfate, 50 ppm Kitasamycin plus 60 ppm Olaquindox), 0.5, or 1% ACTIVATE. During d 5 to 14 after E. coli K88+ challenge, pigs fed AGP, 0.5, or 1% ACTIVATE had higher gain than controls (P<0.01). Furthermore, control pigs had the worst GF among all treatments (P<0.03). On d 14, compared to the control pigs, pigs fed 0.5% ACTIVATE had higher lactobacilli in the duodenum, and pigs fed AGP and 1% ACTIVATE tended to have higher lactobacilli in the ileum (P<0.08). Pigs fed AGP, 0.5% or 1% ACTIVATE diets tended to have lower ileal E. coli counts compared to the controls (P<0.08). Serum interleukin-6, cortisol, or digesta pH values were not affected by treatment (P=0.11). These results indicate that AGP and organic acid blend ACTIVATE can improve growth performance of weaned pigs, mainly via modulating intestinal microflora populations or somatotrophic axis.

Key Words: Antibiotics, Growth Performance, Organic Acid

873 Dietary supplementation with glycyrrhetinic acid (GA) increases endogenous arginine provision and growth performance in milk-fed piglets. Z. S. He[1], Y. L. Hu[2], Y. L. Yin*[1,3], R. L. Huang[1], X. F. Kong[1], T. J. Li[1], F. W. Li[1], and G. Y. Wu[1,3], [1]*Institute of Subtropical Agriculture, The Chinese Academy of Sciences*, *Changsha, Hunan, China*, [2]*Nanjing Agricultural University*, *Nanjing, Jiangsu, China*, [3]*Texas A&M University*, *College Station*.

Physiological levels of cortisol stimulate intestinal arginine synthesis in piglets. Interestingly, some herbal extracts contain GA (a pentacyclic triterpenoid derivative of the β-type amyrin), which has a chemical structure similar to cortisol. This study was conducted to test the hypothesis that dietary GA supplementation may increase arginine availability and growth performance in young pigs. In Experiment 1, 20 piglets (Landrace x Yorkshire) with similar BW (2.92 ± 0.10 kg) were obtained from 5 sows (4 piglets/sow) and weaned at 7 d of age to a liquid milk-replacer diet. After a 2-d period of adaptation, piglets were assigned randomly to one of the 4 treatments, representing supplementation with 0, 0.01, 0.02 or 0.04% GA to the milk powder for 12 d (1 piglet/pen; 5 pigs/treatment). Dietary supplementation with 0.02% GA resulted in highest ADG among all the treatment groups (P<0.05). Experiment 2 was conducted as Experiment 1, except that 9-d-old pigs were fed a liquid milk diet supplemented with 0 or 0.02% GA for 12 d (n=15 pigs/group). On d 0, 5, and 12, BW was measured and venous blood samples were obtained for the analysis of hematology and amino acids. Compared with the control, dietary supplementation with 0.02% GA increased feed intake by 27%, ADG by 47%, and the gain:feed ratio by 17%, while reducing scour frequency by 40% (P<0.05); increased the ratio of lymphocytes to leukocytes by 12-13% and reduced the ratio of neutrophils to leukocytes by 20-27%, while elevating mean corpuscular hemoglobin concentrations by 5% (P<0.05); and increased plasma arginine concentrations by 25% (P<0.05). These results suggest that GA enhances the endogenous provision of arginine and growth performance of milk-fed piglets.

Key Words: Glycyrrhetinic Acid, Pigs, Arginine

874 Dietary arginine supplementation enhances the immune status of piglets. B. E. Tan[1], Y. L. Yin*[1], X. F. Kong[1], T. J. Li[1], R. L. Huang[1], P. Zhang[1], F. G. Yin[1], I. Shinzato[2], S. W. Kim[3,4], and G. Y. Wu[1,4], [1]*Institute of Subtropical Agriculture, The Chinese Academy of Sciences*, *Changsha, Hunan, China*, [2]*Ajinomoto*, *Tokyo, Japan*, [3]*Texas Tech University*, *Lubbock*, [4]*Texas A&M University*, *College Station*.

The study was conducted to determine effects of dietary L-arginine (Arg) supplementation on the immune status of 7- to 21-d-old pigs fed a milk replacer diet, which consisted of 60% dried whey, 26% dried skim milk, 6.2% a-casein, 3.6% lactose, 1.65% glucose, 1% calcium lactate, 1% dihydrocalcium phosphate, 0.1% vitamin premix, 0.2% mineral premix, 0.1% lysine, 0.1% methionine, and 0.05% antibiotic. Seventy piglets (Landrace×Yorkshire) were weaned at 7 d of age and assigned randomly to one of the five treatments (14 piglets/treatment), representing supplementation with 0% (control), 0.2%, 0.4%, 0.6% or 0.8% Arg to the milk replacer powder. Milk powder was dissolved in water to obtain 18% DM, and the resultant liquid milk was fed to piglets every 4 h for 14 d. On d 7, the ratio of spleen weight to BW and serum concentrations of immunoglobulin (Ig) M were higher and serum concentrations of interleukin (IL)-8 were lower in Arg-supplemented piglets compared with control piglets (P<0.05). On d 14, the ratio of thymus weight to BW in piglets supplemented with 0.6% dietary Arg and the numbers of white blood cells (WBC) and blood lymphocytes in piglets supplemented with 0.8% dietary Arg were higher than those in control piglets (P<0.05). On d 14, the numbers of WBC and blood granulocytes as well as serum concentrations of IL-1Ã*f*Å½Ã‚Â² were higher in piglets supplemented with 0.4% dietary Arg, compared with control piglets (P<0.05). Dietary supplementation with 0.6% and 0.8% Arg enhanced lymphocyte proliferation in response to phytohaemagglutinin and increased serum concentrations of IgG and tumor necrosis factor, compared with control piglets (P<0.05). Collectively, these findings suggest that dietary Arg supplementation is beneficial for improving immune function in piglets.

Key Words: Arginine, Immune-function, Piglets

875 Evaluation of different additives in weaned pigs raised in a commercial setting. K. J. Touchette[1], M. D. Newcomb[1], J. A. Cuaron[2], G. Lanz-Arias[2], and D. W. Giesting*[1], [1]*Cargill Animal Nutrition*, *Elk River, MN*, [2]*INIFIAP/PAIPEME*, *Queretaro, Qro., Mexico*.

A trial was conducted with 244 weaned pigs (19.6 d, 6.15 ± .34 kg) to evaluate the effect of additives alone or in combination with antibiotics on nursery performance. The pigs were weaned and assigned to one of 6 treatments in a 2x3 factorial arrangement in a RCBD with 2 levels of antibiotics (AB, none or added) and 3 levels of additives (none, ADD3, or ADD4). The antibiotic used in this study was carbadox fed at 55 mg/kg. The additives used in this study were combinations of enzymes, sweetener, a *Bacillus* DFM, and a plant extract. The ADD3 trt contained the first 3 additives, and the ADD4 trt contained all 4 additives. Pigs were fed a 3-phase, 28 d nursery program with diet changes on d 7 and 21. For phase 1, there were no effects of treatment on animal performance. For phase 2, treatment did not affect feed intake, while pigs fed either ADD3 or ADD4 had improved ADG ($p < 0.001$) and G/F ($p < 0.004$) versus the diets with no additives, while AB did not affect ADG or G/F. For phase 3, AB improved ADFI ($p < 0.02$) compared to no AB, and both ADD3 and ADD4 treatments improved ADFI ($p < 0.04$) compared to the diet with no additives. For both ADG and G/F, there were AB x additive interactions ($p < 0.03$), with no effect of either additive when in diets without, but an improvement in ADG in diets with AB. Adding additives to diets without AB decreased G/F, while adding additives to diets with AB increased G/F. For the entire 28 d trial, AB improved ADFI ($p < 0.04$), while there were interactions for ADG and G/F ($p < 0.003$). Both additives had no effect on ADG or G/F in diets without AB, while they improved ADG and G/F in diets with AB. This study demonstrates that both additives and antibiotics improved nursery performance.

Key Words: Swine, Antibiotics, Additives

876 The interaction of dietary energy and an *E. coli* phytase enzyme on the performance of weanling pigs. A. D. Beaulieu*[1], J. F. Patience[1], T. M. Parr[2], C. L. Wyatt[2], and M. R. Bedford[2], [1]*Prairie Swine Centre, Inc.*, *Saskatoon, SK, Canada*, [2]*Syngenta Animal Nutrition*, *RTP, NC*.

Supplementation of swine diets with phytase enzyme improves the digestibility and retention of phytate-bound P. Phytate complexes other nutrients; however, the data demonstrating an improvement in the utilization of these nutrients is equivocal. The objective of this experiment was to examine the interaction of dietary energy and an

E. coli derived phytase (Quantum™) on weanling pig performance. A total of 406 pigs (9.30 ± 0.51 kg) were utilized in a 42-d experiment. Pelleted phase 1 and 2 diets were fed for 2 and 4 wks, respectively. Treatments consisted of a positive control (PC: 3.48 and 3.52 Mcal DE/kg in phases 1 and 2, respectively) and 6 additional treatments arranged as a 3 x 2 factorial (3 DE levels [HI: 3.45 and 3.49, MED: 3.41 and 3.45, LO: 3.37 and 3.40 Mcal DE/kg for phases 1 and 2, respectively]; 0, 500 FTU phytase/kg). The PC contained 0.32 and 0.23% aP and 0.70 and 0.60% Ca in phases 1 and 2, respectively. Treatment diets contained 0.18 and 0.09% aP and 0.58 and 0.48% Ca in phases 1 and 2. To exploit the factorial arrangement, the initial statistical analysis excluded the PC. Overall ADG improved from 500 to 560 g/d (P<0.001), ADFI from 900 to 950 g/d (P<0.01) and FCE from 0.58 to 0.62 (P<0.05) with 500 FTU/kg phytase. Phytase by energy interactions were non-significant (P>0.05); thus, the analysis examining the effect of energy also excluded the phytase treatments. Increasing DE improved ADG, FCE (linear, P<0.02) and ADFI (quadratic, P<0.05). The ADG and FCE of the PC were similar to HI (P>0.15) regardless of phytase supplementation, but similar to MED and LO only when 500 FTU/kg phytase was included (P>0.20). The ADG and FCE of the PC were improved (P<0.02) relative to the MED and LO treatments when no enzyme was added. Regardless of the diet DE content, phytase improved ADG and FCE in weanling pigs. Based on ADG and FCE, 500 FTU/kg of an *E. coli* derived phytase provided approximately 100 kcal DE/kg when added to the diets of weanling pigs.

Key Words: Weanling Pigs, Phytase, Dietary Energy

877 Bioavailability of iron in an organic iron source for young pigs. G. L. Cromwell*, M. D. Lindemann, and H. J. Monegue, *University of Kentucky*, *Lexington*.

An experiment involving 96 pigs was conducted to determine the bioavailablity of Fe in an organic Fe source (Bioplex®Fe, Alltech, Nicholasville, KY) (OrgFe) relative to the bioavailability of Fe in an inorganic Fe source ($FeSO_4 \bullet H_2O$) (FeSul). Pigs not injected with Fe at birth were weaned at 17-22 d of age and fed a low-Fe diet for 4-5 d, resulting in low hemoglobin (Hb, 4.1 g/dl) and hematocrit (Hct, 17.9%) levels. The pigs (n=84, intial BW=5.5 kg) were allotted to 7 treatments with 6 replications of 2 pigs/pen. Treatments were a low-Fe basal diet (35 ppm Fe) and the basal with 14, 28, or 42 ppm added Fe from OrgFe or the basal with 14, 28, or 42 ppm added Fe from FeSul. An 8th treatment consisted of 12 positive control (PC) pigs injected with 150 mg Fe at birth and fed the basal diet with 150 ppm added Fe as FeSul during the study. These pigs had initial Hb of 10.4 g/dl and Hct of 36.8%. Diets were fed on an ad libitum basis and pigs were on plastic coated floors. At the end of the 28-d study, 4 pigs/treatment were killed and liver, heart, spleen, and kidneys were collected for Fe determination. Increasing the Fe level from either Fe source resulted in linear (P<0.001) increases in ADG (257, 339, 430, 438, 372, 424, 452 g for treatments 1 to 7, respectively). ADG for the PC pigs was 565 g. Hb and Hct also responded to added Fe from the 2 sources (4.82, 6.51, 7.28, 8.73, 7.14, 8.00, 9.95 g/dl; 20.8, 24.9, 28.3, 31.1, 27.1, 29.5, 35.2%). Levels of Hb and Hct for the PC pigs were 12.33 g/dl and 40.5%. Liver Fe (ppm of DM) was 15.3, 18.8, 25.5, 29.0, 28.8, 31.3, 43.5, 99.0 and total liver Fe was 1.31, 1.77, 2.93, 3.65, 3.16, 3.37, 4.97, 14.13 mg for the 8 treatments. Hb, Hct, and liver Fe responded linearly (P<0.001) to added Fe from either source, and the responses were greater for FeSul than for OrgFe (P<0.001). Hb, Hct, and liver Fe were regressed on Fe intake for each Fe source with the basal included in both regressions. Based on slope ratios, the bioavailability of Fe in the organic Fe source was 80 to 85% of the bioavailability of Fe in FeSul. Based on this study, the Fe in Bioplex®Fe seems to be less available to pigs than the Fe in $FeSO_4 \bullet H_2O$.

Key Words: Pigs, Iron, Bioavailability

878 A comparison of water delivered direct fed microbials or organic acids with in-feed antibiotics on weanling pig growth performance, intestinal morphology, gut microbiota and immune status following a *Salmonella typhimurium* challenge. M. C. Walsh*[1], D. M. Sholly[1], K. L. Saddoris[1], B. E. Aldridge[1], A. L. Sutton[1], M. H. Rostagno[2], B. T. Richert[1], and J. S. Radcliffe[1], [1]*Purdue University*, *West Lafayette, IN*, [2]*USDA Livestock Behaviour Unit*, *West Lafayette, IN*.

Pigs (n=88) weaned at ~19 d of age were used in a 14 d experiment to compare the effects of water delivered direct fed microbials (DFM) or a propionic acid based blend with in-feed antibiotics on growth performance, intestinal morphology, gut microbiota and immune status following a *Salmonella typhimurium* challenge. Treatments were: 1) negative control (NC), 2) Trt. 1 + water supplied DFM (*Enterococcus faecium, Bacillus subtillis, Bacillus licheniformis*, Chr Hansen, Inc.), 3) Trt. 1 + water supplied propionic acid based blend (PA blend, 2.58 mL/L; Kem San®)and 4) Trt. 1 + in feed antibiotics (carbadox, 55 ppm). Pigs were challenged intra-nasally with *Salmonella typhimurium* on d 6 post-weaning, and harvested (22 pigs/d) on d 6 (prior to challenge), 8, 10 and 14 post-weaning. Water delivered DFM or PA blend or in feed antibiotics improved ADG (P<0.05) on d 2-4 post-challenge compared to NC pigs. Water supplied DFM tended (P<0.10) to increase G:F from d 0-5 pre-challenge compared to NC pigs. Water supplied DFM increased (P<0.05) duodenal villus height on d 4 post-challenge compared to pigs receiving carbadox or NC pigs. Water delivered PA blend tended (P<0.10) to decrease Enterobacteriaeace counts in the cecum on d 0 and 2 post-challenge compared to the DFM treatment. Salmonella presence in the ileum, cecum and mesenteric lymph nodes was not different among treatments at any time point post-challenge. However, the proportion of pigs shedding salmonella in the feces was decreased 100 and 50% by DFM and PA blend treatments, respectively, on d 5 post-challenge. There were no treatment differences in TNFα concentrations in serum, duodenal, jejunal, or ileal tissue at any time point post-challenge. However, serum TNFα linearly increased (P<0.04) through d 4 post-challenge for all treatments. Treatments had no effect on microbial presence and/or concentrations in the gastrointestinal tract, but did improve growth performance and intestinal morphology following a salmonella challenge.

Key Words: Pig, Direct Fed Microbials, Water Acidification

879 Influence of diet and manure management on growth performance and carcass characteristics of wean-finish pigs. D. M. Sholly*, R. B. Hinson, K. L. Saddoris, M. C. Walsh, A. L. Sutton, B. T. Richert, and J. S. Radcliffe, *Purdue University*, *West Lafayette, IN*.

A total of 1,920 pigs (initial BW=5.8 kg) were used in a 2 x 2 factorial, 153 d wean-finish experiment to determine the effects of diet (CTL or LNE) and manure management (deep pit, DP vs. monthly pull

plug-recharge, PP) on growth performance, live ultrasound scans, and carcass characteristics. The CTL and LNE diets were corn-SBM based and had equal Lys:calorie. The LNE diets had reduced CP and P, increased synthetic amino acids, contained a non-sulfur trace mineral premix and added fat. Pigs were housed in a 12 room environmental building, with 30 barrows and 30 gilts per room. Split-sex and phase feeding (9 phases) were used to meet or exceed the nutrient requirements of pigs (NRC, 1998) at different stages of growth. Nursery ADFI was greater for pigs fed the CTL diet compared to LNE fed pigs (1.00 vs. 0.96 kg/d; P<0.05), but ADG and d 56 BW (avg BW=37.0 kg) were not different (P>0.05). The LNE diet tended to improve nursery G:F over the CTL diet (0.45 vs. 0.42; P=0.06). Grow-finish ADG, G:F, and market BW were greater (0.97 vs. 0.94 kg/d, 0.39 vs. 0.35, and 130.1 vs. 125.4 kg, respectively; P<0.05) for LNE fed pigs compared to CTL fed pigs. Market BW pigs fed LNE diets had a greater loin eye area (LEA) and backfat compared to CTL fed pigs (40.7 vs. 38.9 cm2 and 20.9 vs. 17.9 mm, respectively; P<0.05). Pigs housed under the DP manure management had greater market BW live scan LEA (40.3 vs. 39.3 cm2; P<0.05) compared to PP manure management. Pigs fed the CTL diet had greater (P<0.05) carcass % lean, however LNE fed pigs had greater carcass % yield, fat depth, and hot carcass wt (P<0.05). Deep pit manure management increased carcass yield (74.83 vs. 73.82%; P<0.05) compared to PP manure strategy. All other carcass characteristics and nursery and grow-finish growth performance were unaffected by manure management. Diet formulation can impact pig performance to a greater extent than either a deep pit or pull plug-recharge manure management system.

Key Words: Pigs, Diet Manipulation, Manure Management

880 Relationship of isoprostanes, biomarker of oxidative stress, and pig productivity. T. S. Stahl*, J. B. Zamzow, D. Wang, and A. E. Atwood, *Iowa State University*, *Ames*.

Variation in a urinary isoprostanes, a biomarker of systemic oxidative stress status, was determined in pigs and its relationship to pig productivity was quantified. An imbalance between oxidative and antioxidative processes within cells results in excess production of reactive oxidative species which in turn create oxidized lipids and potential cell dysfunction. These cell dysfunctions include a greater loss of cellular energy and a potential redirection of energetic pathways. Four female pigs from each of 27 litters were selected from a single sow strain and herd and reared in a common environment. Pigs were individually penned, self-fed a nutritionally adequate diet and weighed weekly from weaning to 126 kg BW. Freshly voided urine was collected and the isoprostane/creatinine (IC, ng/mg) content determined at BW (±3) of 6, 18, 54, 90 and 126 kg. Urinary IC varied (P<.01) among litters and stage of growth. Urinary IC were elevated in young pigs and declined as the pigs grew, averaging 28.8, 18.3, 5.1, 2.9 and 1.6 ng/mg at 6, 18, 54, 90 and 126 kg BW, respectively. Urinary IC was elevated in small birth weight pigs initially (at 6, 18 kg BW) but not at later stages of growth. Urinary IC at 54 and 90 kg BW was negatively associated (P<.02) with efficiency of feed utilization from BW of 36-72 and 72-108 kg, respectively, but not daily BW gain. Each 1 ng increase in urinary IC at 54 and 90 kg BW was associated with an additional .02 and .04 kg of feed per unit BW gain. From the last 75 pigs to reach 126 kg BW, pigs (11 pigs/group) with mean urinary IC at 54-90 kg BW in the highest and lowest 15% of the sample population were killed at 135 kg BW and their carcass traits evaluated. The high urinary IC pigs possessed greater subcutaneous backfat (20.8 vs. 16.6 mm, tenth rib) and leaf fat (1.94 vs. 1.31 kg). Based on these data, greater oxidative stress in pigs is associated with less efficient feed utilization and the accumulation of body fat.

Key Words: Isoprostanes, Energetic Efficiency, Pigs

881 The impact of coating on thermostability and bioefficacy of phytase in weaned pigs fed corn-soybean meal based diets. A. Owusu-Asiedu[1], P. H. Simmins[1], J. L. Landero[2,3], and R. T. Zijlstra*[3], [1]*Danisco Animal Nutrition*, *Marlborough, UK*, [2]*Universidad Autónoma de Baja California*, *Mexicali, México*, [3]*University of Alberta*, *Edmonton, AB, Canada*.

A study evaluated the effects of a new coating on thermal tolerance and bioefficacy of a bacteria-derived, phytase product Phyzyme XP (6-phytase, EC 3.1.3.26; U-phytase) against the same phytase with a thermo-protective coating (Phyzyme XP-TPT; C-phytase) in weaned pigs fed corn-soybean meal-based diets. Individually-housed 28-day-old pigs weaned at 21 d with average initial BW of 8.20 kg (8 pigs per treatment) were randomly allotted to 7 dietary treatments based on corn-soybean meal for a 21 d. The treatments were: 1, Positive Control (PC) mash; 2, Negative Control (NC) mash; 3, NC pelleted at 90°C; 4, NC + 500 U/kg U-phytase; 5, NC + 500 U/kg C-phytase; 6, NC + 500 U/kg C-phytase pelleted at 80°C; and 7, NC + 500 U/kg C-phytase pelleted at 90°C. The PC and NC diets were formulated to be isocaloric and isonitrogenous. Calcium content was 1.01 and 0.83% and available P content was 0.40 and 0.22% in the PC and NC diets, respectively. Pig BW and feed intake were measured on d 7, 14, and 21. Data were analyzed as a CRD using ANOVA. Pigs fed the PC performed better than those fed the NC (P<0.05). Both the U-phytase and C-phytase increased ADG and improved G:F (P<0.05) but not ADFI in mash diets compared with the negative control. Compared to NC diets pelleted at 90°C, G:F for C-phytase diet pelleted at 90°C improved (P<0.05) by 16%. Other performance variables were not significantly different (P>0.05) in pigs fed C-phytase in mash diets or diets pelleted at 80 and 90°C diets compared with U-phytase diet. In conclusion, in diets limiting in Ca and P, a coated phytase product in mash or diets pelleted at 90°C improved performance of weaner pigs indicating that phytase bioefficacy remained intact.

Key Words: Phytase, Pelleting, Weaned pig

882 Enzymatic comparisons of *Aspergillus niger* PhyA and *Escherichia coli* AppA2 phytases. A. H. J. Ullah[2], J. D. Weaver*[1], K. Sethumadhavan[2], E. J. Mullaney[2], and X. G. Lei[1], [1]*Cornell University*, *Ithaca, NY*, [2]*SRRC, ARS, USDA*, *New Orleans, LA*.

Both *Aspergillus niger* PhyA and bacterial *Escherichia coli* AppA2 have been used to increase phosphorus bioavailability and decrease excreta phosphorus content in simple-stomached animals. Although different feeding efficiencies have been observed with these two phytases, it remains unclear whether or not this difference is due to inherent enzymatic properties of these proteins. The objective of our study was to compare the kinetic properties of these two enzymes at the commonly observed stomach pH 3.5. Both PhyA and AppA2 were expressed in the same *Pichia pastoris* host using a constitutive expression system, and purified to >95% homogeneity using two steps of ion-exchange chromatography. While AppA2 had a lower affinity

to phytate with a higher K_m (74 vs. 34 μM, P < 0.01) than PhyA, this bacterial enzyme displayed a greater (P < 0.01) V_{max} (1,070 vs. 120 μmol min^{-1} mg^{-1}), k_{cat} (840 vs. 170 sec^{-1}) and k_{cat}/K_m ($1.1x10^7$ vs. $0.5x10^7$ M^{-1} sec^{-1}) than that of PhyA. PhyA and AppA2 had optimal temperatures of 65°C (pH 5.0) and 58°C (pH 3.5), respectively. Both enzymes had two pH optima at 37°C: PhyA with a peak at 2.0 and a greater peak at 5.5, while AppA2 had a peak at 3.4 and a greater peak at 5.0. PhyA was nearly twenty times more resistant to competitive inhibition by myo-inositol hexasulfate than AppA2 (K_i = 3.9 vs. 0.2 μM). Likewise, 4 times more (1.4 vs. 0.3 M) guanidine hydrochloride was required to produce the same 50% inhibition of enzyme activity for PhyA than AppA2. Overall, AppA2 possesses superior kinetic properties compared to PhyA at pH 3.5, which helps in catalyzing phytate hydrolysis at commonly observed gastric conditions of simple-stomached animals.

Key Words: Phytase, Kinetics, Enzymology

883 Effects of dietary electrolyte balance and molasses in diets with corn-based distillers dried grains with solubles on growth performance in nursery and finishing pigs. C. Feoli*[1], J. D. Hancock[1], S. M. Williams[1], T. L. Gugle[1], S. D. Carter[2], and N. A. Cole[3], [1]*Kansas State University*, *Manhattan*, [2]*Oklahoma State University*, *Stillwater*, [3]*USDA/ARS*, *Bushland, TX*.

Two assays were conducted to determine the effects of dietary electrolyte balance (dEB) and molasses in diets with corn-based distillers dried grains with solubles (DDGS, Sioux River Ethanol, Hudson, SD) on growth performance of nursery and finishing pigs. For the first experiment, 126 nursery pigs (35 d old and avg BW of 10.2 kg) were assigned with six pigs/pen and seven pens/treatment. Treatments were a corn-soybean meal-based control and diets with DDGS as 30% of the formula without and with 0.93% sodium bicarbonate to bring dEB to 64 meq/kg [(Na + K) × (Cl + S)] as in the control. Diets were formulated to 1.4% Lys, 0.75% Ca, and 0.35% available P. Pigs fed the control diet had greater ADG (P < 0.03) and ADFI (P < 0.08) but did not differ in G:F (P > 0.6) compared to those fed diets with DDGS. Addition of sodium bicarbonate did not improve growth performance (P > 0.3). For the second experiment, a total of 70 gilts (avg BW of 60.5 kg) were assigned with two pigs/pen and five pens/treatment. The pigs were fed the experimental diets for 26 d, fed a common diet for 6 d, and then reassigned to a different treatment for an additional 26-d assay. The end result was 10 pens per treatment. Treatments were a corn-soybean meal-based control and diets with DDGS as 40% of the formula without and with 5% molasses and sodium bicarbonate (none, 1, and 2%) arranged as a 2 x 3 factorial plus control. Diets were formulated to 0.9% Lys, 0.6% Ca, and 0.22% available P. Pigs fed the control diet had greater ADG and ADFI (P < 0.001) but did not differ in G:F (P > 0.4) compared to those fed diets with DDGS. Adding molasses and(or) sodium bicarbonate did not affect ADG (P > 0.5) or ADFI (P > 0.14) and adding molasses actually decreased (P < 0.03) G:F. In conclusion, adding sodium bicarbonate and(or) molasses to diets with DDGS did not improve growth performance in nursery or finishing pigs.

Key Words: Distillers Dried Grains, dEB, Pig

Physiology & Endocrinology - Livestock and Poultry: Reproductive Physiology

884 Emerging concepts regarding the integration of neuroendocrine signals that regulate gonadotropin secretion in domestic livestock. C. A. Lents*[1] and C. R. Barb[2], [1]*The University of Georgia*, *Athens*, [2]*USDA-ARS, Russell Research Center*, *Athens, GA*.

The pulsatile discharge of GnRH from hypothalamic neurons is obligatory for the synthesis and release of the pituitary gonadotropins. Many conditions have been characterized that reduce gondadotropin secretion and result in anovulatory states which contribute to inefficiencies in livestock production. Nutrient intake, body energy reserves, suckling, and season are all major regulators of gonadotropin secretion in mammals. Lack of adequate gonadotropin secretion during the pre-pubertal and postpartum periods adversely impact the reproductive efficiency of domestic herds and flocks. These various anovulatory states typically have one fundamental similarity; a lack of hypothalamic release of GnRH. For the most part, pituitary function remains intact, as indicated by the release of gonadotropin from the anterior pituitary gland in response to exogenous GnRH. Identifying the hormonal and metabolic factors that mediate the central effects of these factors on the GnRH neuronal network in the brain has been an intensely studied area. Additionally, season and metabolic status seems to enhance the central mechanism of estradiol negative feedback on LH secretion. Despite much progress, identifying the mechanisms that directly mediate these actions on GnRH neurons in a consistent and well regulated fashion has proven difficult. For example, GnRH neurons appear to lack estrogen receptors, suggesting that feedback effects of estrogen are mediated through interneuronal systems. A role for the peptide hormone kisspeptin as a major regulator of gonadotropin secretion has recently emerged. Recent reports have demonstrated a potential role of kisspeptin in regulating the onset of puberty as well as mediating metabolic and photoperiodic control of reproduction in rodents. The purpose of this review is to summarize what is currently known regarding kisspeptin in domestic livestock and postulate the role it may have in regulating reproductive function of these larger mammalian species.

Key Words: Kisspeptin, Gonadotropin, Reproduction

885 Effects of human chorionic gonadotropin (hCG) and gonadotropin releasing hormone (GnRH) on follicle and corpus luteum dynamics and concentrations of progesterone in pre-pubertal Angus heifers. C. R. Dahlen*[2], J. E. Larson[1], G. Marquezini[1], and G. C. Lamb[1], [1]*North Central Research and Outreach Center, University of Minnesota*, *Grand Rapids*, [2]*Northwest Research and Outreach Center, University of Minnesota*, *Crookston*.

We determined the effects of administering human chorionic gonadotropin (hCG) on subsequent follicle and corpus luteum dynamics and concentrations of progesterone in pre-pubertal heifers. Forty-seven purebred, pre-pubertal Angus heifers were stratified by age and weight and assigned randomly to one of three treatments: 1) heifers received a 100 μg injection of GnRH (GnRH; n = 16); 2) heifers received a 1,000 IU injection of hCG (H1000; n = 16); and 3) heifers received a 500 IU

injection of hCG (H500; n = 15). From d -1 to 9 relative to treatment daily blood samples were collected to determine concentrations of progesterone and ovaries of each heifer were examined daily by transrectal ultrasonography using a 7.5Mhz transducer. Diameter of all follicles larger than 5 mm and all corpora lutea (CL) were measured and recorded. A greater percentage ($P < 0.05$) of heifers in the H1000 treatment (87.5%) ovulated compared with GnRH heifers (43.8%), whereas H500 heifers (73.7%) were intermediate. A greater percentage ($P < 0.05$) of H1000 (87.5%) and H500 (73.3%) heifers developed a CL compared with GnRH heifers (18.8%). The largest follicle present on ovaries of H1000 and H500 heifers was smaller ($P < 0.05$) from d 2 to 5 than that of GnRH heifers. Concentrations of progesterone peaked on d 6 for all treatments. Heifers treated with H1000 (1.72 ng/ml) had peak concentrations of progesterone that were greater ($P < 0.05$) than H500 heifers (1.34 ng/ml), which were greater ($P < 0.05$) than heifers treated with GnRH (0.31 ng/ml). Mean volume of luteal tissue was greater ($P < 0.05$) in H1000 heifers (1.54 cm^3) than in H500 heifers (1.15 cm^3), which was greater ($P < 0.05$) than in heifers treated with GnRH (0.23 cm^3). We concluded that hCG was more effective than GnRH in its ability to ovulate follicles, increase volume of luteal tissue in the subsequent developing CL, and concentrations of progesterone in pre-pubertal heifers. In addition, hCG appears to be more effective when administered at 1,000 IU than 500 IU.

Key Words: Human Chorionic Gonadotropin, Estrous Synchronization, Beef Heifers

886 Increasing ovulation rate reduced follicle size and increased blood progesterone concentrations but had no effect on fertility in cattle selected for twins. S. E. Echternkamp*, R. A. Cushman, and M. F. Allan, *USDA, ARS, U.S. Meat Animal Research Center*, *Clay Center, NE*.

Smaller ovulatory follicles (F) and lower progesterone concentrations during the luteal phase after breeding reportedly decrease fertility and embryonic survival in cattle. Diameter of individual F and corpora lutea (CL), blood progesterone concentrations, and conception to AI were compared among cows with ovulation rate (OR) records of one (n = 74), two (n = 253), three (n = 88), or four (n = 6) CL in 2004 to 2006; herd mean for OR was 2.09. Number and diameter of F and subsequent CL were determined by ultrasonography at 12 h after onset of estrus and 8 to 15 d after AI, respectively, and number of fetuses at 60 d after AI. Progesterone was quantified by RIA in a single blood sample collected at CL diagnosis. Data were analyzed by SAS PROC MIXED procedures; main effects in the models were OR, day, fetal status, and year. Follicle diameter was smaller ($P < 0.01$) in 2006. Follicle and CL diameter were correlated ($r = 0.53$; $P < 0.01$) and decreased ($P < 0.01$) with increasing OR (1 CL = 17.1 ± 0.3 and 23.3 ± 0.4 mm, 2 CL = 14.0 ± 0.1 and 20.2 ± 0.4 mm, 3 CL = 12.6 ± 0.2 and 18.1 ± 0.3 mm, 4 CL = 11.7 ± 0.5 and 16.7 ± 0.7 mm, respectively), but diameter were similar for fertile (fetus) and infertile ovulations (13.9 ± 0.1 and 19.8 ± 0.4 mm vs. 13.8 ± 0.1 and 19.4 ± 0.4 mm, respectively). Fetal number per female increased ($P < 0.01$) with OR (0.56 ± 0.11, 1.04 ± 0.06, 1.47 ± 0.10, and 1.80 ± 0.26 for 1, 2, 3, and 4 CL, respectively), but the fetus:ovulation ratio (0.52 ± 0.3) was unaffected. OR did not affect pregnancy rate (65.6 ± 0.3%) at 60 d after AI. Progesterone concentrations increased ($P < 0.01$) with OR (1 CL = 7.1 ± 0.3, 2 CL = 8.9 ± 0.2, 3 CL = 9.7 ± 0.3, 4 CL = 8.5 ± 0.7 ng/ml) and from d 8 (6.3 ± 0.5 ng/ml) to 14 (10.6 ± 0.5 ng/ml). Progesterone concentrations did not differ between pregnant and nonpregnant cows (8.8 ± 0.3 vs. 8.2 ± 0.3 ng/ml). Decreased follicle size and increased progesterone in cows with natural multiple ovulations did not affect conception.

Key Words: Cattle, Fertility, Ovulation Rate

887 Altered liver gene expression and reproductive function in postpartum suckled beef cows on different planes of nutrition. M. Bionaz*[1], F. Samadi[2], M. J. D'Occhio[2,3], and J. J. Loor[1], [1]*University of Illinois*, *Urbana*, [2]*The University of Queensland*, *Gatton Campus, Australia*, [3]*CRC for Beef Genetic Technologies*, *Gatton Campus, Australia*.

The effect of caloric restriction on long-term liver gene expression was evaluated using Droughtmaster cows (n = 5/diet) assigned to improved (IP) or moderate pasture (MP) from 6 mo of gestation through 14 wk of lactation. Ovarian follicular status and blood IGF-1, insulin, and glucose postpartum were determined weekly. Liver was biopsied at 1, 6, and 14 wk postpartum and RNA used to measure expression of genes (qPCR) with key functions in fatty acid metabolism (*PPARA*, *CPT1A*, *ACOX1*, *ADIPOR2*, *HNF4A*, *SREBF1*), cholesterol metabolism (*APOB*, *HMGCR*, *PPARD*, *SREBF2*), insulin signaling (*IRS1*, *FRAP1*), gluconeogenesis (*PCK1*, *FBP1*, *PC*), reproductive function (*IGF1*, *GHR*, *SHBG*, *SIRT1*), signal transduction (*IGFBP1*), regulation of cell growth (*IGFBP2*), and oxidative stress (*SOD1*). Cows on IP had greater ($P < 0.05$) BW (+57 kg) and BCS (3.7 vs. 2.3) at parturition, and greater plasma concentrations of insulin (5.9 vs. 3.8 μIU), glucose (3.9 vs 3.4 mmol/L), and IGF-1 (191 vs. 145 ng/mL) postpartum. All IP cows resumed ovulation between 12-15 wk postpartum compared with only one MP cow. Effects of caloric restriction on liver gene expression were most evident at wk 6 when IP cows had greater ($P < 0.05$) expression (1.5 to 2.9-fold) of *ACOX1*, *ADIPOR2*, *CPT1A*, *FRAP1*, *GHR*, *HNF4A*, *IRS1*, *PPARA*, *PPARD*, *SCD*, *SHBG*, *SREBF1*, and *SREBF2*. Temporal effects of diets on gluconeogenesis, cholesterol synthesis/metabolism, and oxidative stress were most apparent between wk 1 and 6, with MP resulting in lower (time × diet $P < 0.06$) mRNA (-1.4 to -2.3-fold) of *HMGCR*, *PC*, *APOB*, *PPARD*, and *SOD1* at wk 6. *IGFBP1* increased between wk 1 and 14 with both IP and MP. However, on wk 6, *IGFBP1* was 3.7-fold greater with MP vs. IP (time × diet $P < 0.05$). *IGFBP2* was greater with MP vs. IP at wk 1 (2-fold), but decreased linearly through wk 14 compared with IP. *SCD* and *SREBF1* expression was lower with MP throughout lactation, suggesting reduced desaturation and fatty acid synthesis in liver. Delayed resumption of ovulation with caloric restriction might be linked to altered metabolic homeostasis driven at least in part by liver genomic adaptations.

Key Words: Liver, Reproduction, Caloric Restriction

888 Luteal function at day 30 of pregnancy in relation to serum progesterone in dairy cows at risk for late embryonic or early fetal mortality. J. D. Rhinehart*[1], J. A. Flores[1], R. A. Milvae[2], and E. K. Inskeep[1], [1]*West Virginia University*, *Morgantown*, [2]*University of Connecticut*, *Storrs*.

Pregnancy failures during placentation have been associated with low concentrations of peripheral serum progesterone (P_4) in lactating dairy cows. Experiments were done to determine if luteal function and/or metabolic clearance rate of injected P_4 differed for cows with high or

low concentrations of serum P_4 on approximately d 30 of gestation. Luteal tissue was removed from pregnant cows with ≥ 4.0 ng/mL (H) or ≤ 2.5 ng/mL (L) serum P_4 during d 28 to 34 post-insemination. Luteal tissue was analyzed for P4 by radioimmunoassay and mRNA expression of preproendothelins 1 and 3, endothelin converting enzyme, endothelin receptors A and B, cyclooxygenase-2, aldoketoreductase 1B5, 15-hydroxyprostaglandin dehydrogenase, and prostaglandin E synthase by real-time RT-PCR. Dispersed luteal cells were incubated for 2 h with bovine luteinizing hormone (bLH) or arachidonic acid (AA), increasing (10^{-10} to 10^{-7}) concentrations of endothelin-1 (ET-1), and combinations of ET-1 and bLH or AA. Neither luteal content of P_4 (mean 106.0 ± 3.3 µg) nor mRNA for genes investigated were correlated with serum P_4 at lutectomy. Both basal and LH-stimulated P_4 secretion from dispersed luteal cells were inhibited ($P < 0.05$) by ET-1 in a dose dependent manner. This inhibition was greater ($P < 0.05$) for luteal cells from L vs. H cows cultured with ET-1 and AA. To evaluate P_4 catabolism, cows were injected s.c. with 150 mg P_4 every 12 h beginning at lutectomy. In jugular blood collected every 4 h until h 48, serum P_4 was maintained at lower ($P < 0.05$) concentrations for L vs. H cows. Area under the curve was less ($P < 0.05$) for L (49.6 ± 6.2) vs. H (83.6 ± 12.5) cows. Metabolic clearance was more important in regulating peripheral concentrations of P than luteal production. However, luteal sensitivity to co-culture with ET-1 and AA was enhanced for cows with low serum P_4. Management practices that reduce metabolic clearance rate of P_4 might decrease late embryonic or early fetal mortality as efficiently as supplementation with exogenous progestogens. Supported by USDA-CSREES-NRI 2002-35203-12230.

Key Words: Embryonic and Fetal Mortality, Progesterone, Lactating Dairy Cow

889 Effect of seminal plasma and transforming growth factor (TGF)-β1 treatment on pregnancy outcome in beef cattle. J. F. Odhiambo*[1], I Holásková[1], J. D. Rhinehart[1], D. H. Poole[2], J. M. DeJarnette[3], E. K. Inskeep[1], and R. A. Dailey[1], [1]*West Virginia University*, *Morgantown*, [2]*Ohio State University*, *Colombus*, [3]*Select Sires Inc*, *Plains City, OH*.

The role of post-mating inflammatory response on pregnancy outcome has been described in rodents, pigs and humans. Transforming growth factor (TGF)-β1 was identified as the active inflammatory-inducing moiety derived from seminal vesicles (Tremellen et al., 1998). The present studies tried to examine in beef cattle the significance of pre-sensitization of the uterus before or at breeding with seminal antigens on pregnancy outcome. Spring calving beef cows (n = 1083) were synchronized for estrus and assigned randomly to treatments during 2003 to 2006. In Trial 1, treatments included 0.5 ml seminal plasma (SP), 80 ng/ml rhTGF-β1 suspended in bovine serum albumin (BSA) and 0.5 ml BSA (control). In Trial 2, two treatments SP and BSA were examined. Trial 3 compared treatment with SP or no treatment (control). Treatments were infused at onset of estrus (12 h before insemination) in Trial 1 or at inseminations (Trial 2 and 3). Pregnancy data were examined by contingency analysis and least squares analysis of variance using the GLM procedures of SAS for effects of treatment, time of treatment, age of cow, year, and their second and third order interactions. Differences were considered significant at $\alpha = 0.05$. In Trial 1, pregnancy rates did not differ (53.1, 54.7 and 54.8 % for BSA, SP and TGF-β1 respectively). In Trial 2, TGF-β1 tended to improve pregnancy outcome compared to SP or BSA in 2005 (49.2 vs. 33.1 and 38.4 %, respectively). In a separate 2005 study, pregnancy rates were 59.4 and 67.0 % for BSA and SP, respectively and tended to be affected by time of insemination. In Trial 3, pregnancy outcome was not different between SP or control, 61.4 and 52.4 % respectively. However, interactions of farm by treatment existed. The data obtained from these studies did not provide any conclusive evidence for the effect TGF-β1 or seminal plasma on pregnancy outcome in beef cattle, although TGF-β1 might improve pregnancy rates when fertility is compromised.

Key Words: Seminal Plasma, TGF-β1, Pregnancy

890 Prolactin and luteinizing hormone profiles during the reproductive cycle in the native Thai chicken. S. Kosonsiriluk[1], N. Sartsoongnoen[1], N. Prakobsaeng[1], I. Rozenboim[2], M. E. El Halawani[3], and Y. Chaiseha*[1], [1]*Suranaree University of Technology*, *Nakhon Ratchasima, Thailand*, [2]*The Hebrew University of Jerusalem*, *Rehovot, Israel*, [3]*University of Minnesota*, *Saint Paul*.

Unlike Gallinacous-temperate zone birds, the reproductive cycle of the native Thai chicken, an equatorial non-photoperiodic continuous breeder consists of three reproductive stages including laying (LAY), incubating (INC) and rearing of young (R). In temperate zone birds, luteinizing hormone (LH) and prolactin (PRL) levels vary during the four reproductive stages with the high PRL levels observed during the incubation phase are responsible for the suppression of gonadotropic hormones and ovarian steroids, follicular atresia, termination of egg laying activity and induction of incubation behavior. PRL action on the reproductive neuroendocrine system has been shown to be mediated by its feedback effects on the hypothalamus, pituitary and ovary. The objective of this study was to establish baseline information on the neuroendocrine changes (LH and PRL levels) associated with reproductive stages of the native Thai hens. Chickens were classified into three stages: LAY, INC and R (n=10). Blood samples were collected for determining plasma PRL and LH levels by Enzyme-Linked immunoSorbent Assay. Daily records were kept of egg production and nesting activity during the reproductive cycle. The results revealed that PRL levels (ng/ml) were low in R (24.1±1.9), intermediate in LAY (40.4±12.6) and highest in INC (351.9±37.1, $P<0.05$). There were no changes ($P>0.05$) in LH levels across the reproductive stages. Levels were 3.4±0.3, 3.7±0.4 and 3.2±0.1 ng/ml, whereas ovarian weights were ($P<0.05$), 35.9±0.9, 3.1±1.2 and 1.9±0.9 gm for LAY, INC and R, respectively. The finding that ovarian regression occurred in INC and R hens in the absence of a decline in LH levels is interpreted as an adaptive mechanism(s) allowing for reinitiating egg laying activity in case of nest destruction at any time and irrespective of the season. The finding further suggest the antigonadotropic effect of PRL is limited to its effect on the ovary.

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Key Words: Bird, Luteinizing Hormone, Prolactin

891 The effect of active immunization against vasoactive intestinal peptide and inhibin on semen production of young and aged roosters. I. Rozenboim* and N. Avital, *Hebrew University of Jerusalem, Faculty of Agriculture, Department of Animal Science*, *Rehovot, Israel*.

Low levels of fertility are causing major economic losses in poultry breeder farms. The objective of this study was to investigate the effect of active immunization against VIP and inhibin on semen production and quality of roosters at different ages. Exp. 1. Sixty WL roosters at 19 wk of age were divided to 4 groups (n=15): 1) control, 2) VIP immunized, 3) Inhibin immunized and 4) immunized against VIP and inhibin. Semen quality was measured every 2 wks, blood samples were collected every other week for plasma steroid levels. At 41 wks of age roosters were killed, hypothalamai pituitaries and testicular tissue were removed and stored for mRNA analysis of GnRH, VIP and LH, FSH, prolactin and LH and prolactin receptors respectively. Exp. 2. Sixty WL roosters at 67 wk of age were treated similarly as in exp 1. All measurements conducted in exp. 1 were similarly conducted. Exp. 3. Twenty eight WL roosters at 97 wk of age were divided to 4 groups (n=7): 1) control, 2) VIP immunized, 3) control + prolactin (1mg/day/bird for 7 days) and 4) VIP immunized + prolactin (1mg/day/bird for 7 days). Results: combined immunization (VIP+inhibin) in young roosters significantly ($P<0.05$) increased semen quality compare to control birds (volume: 0.78 ± 0.01 ml vs. 0.6 ± 0.01 ml, concentration: 3.7×109 vs. 3.5×109 (cells/ml) and mobility 0.6 vs. 0.2 O.D.). In elderly birds VIP immunization significantly ($P<0.05$) reduced semen concentration, volume, motility and mobility compare to all other treatment groups. In addition active immunization against inhibin significantly increased mobility value compare to control group (1.4 vs. 0.9 O.D.) and semen motility (8 vs. 7.2) Prolactin administration (Exp. 3) to old roosters previously actively immunized against VIP significantly improved semen quality manifested by increase in concentration from $2.1 \times 109 \pm 0.1$ to 3.1×109 (cells/ml), mobility from 0.9 to 1.15 and motility from 6 to 7.5. As in mammalian species, prolactin was found to be involved in semen production of old roosters. The mechanism of this phenomenon involves testicular prolactin and LH receptors, since prolactin significantly elevated testicular LH receptors mRNA in this study.

Key Words: Rooster, Semen, Prolactin

892 Chicken epiregulin (ER) gene: cDNA cloning, genomic organization, and regulation of its mRNA expression in ovarian granulosa cells. Y. Wang*, J. Li, and F. C. Leung, *The University of Hong Kong*, *Hong Kong, HK-SAR, China*.

Growing evidence suggests that epiregulin (ER), a ligand of epidermal growth factor receptor (EGFR), is involved in controlling follicular development in mammals. However, there is no information on its expression in the ovary of non-mammalian species including chicken. In this study, we first cloned the full-length cDNA of chicken epiregulin gene from ovary. The cloned cDNA is 948 bp in length and encodes a membrane-anchored precursor of 153 amino aicds, which shares high sequence identity (~59%) with its mammalian counterpart. Genomic structural analysis shows that chicken epiregulin gene spans approximately 8 kb on chromosome 4 and consists of 5 exons. Using RT-PCR assay, ER mRNA was detected to be expressed in embryonic (embryonic day 20), sexually immature (3 week), and mature ovaries (6 chickens used at each stage), suggesting a role of ER in ovarian development. Compared with the other six EGFR ligands, epiregulin appeared to be expressed at a low level. However, using semi-quantitative RT-PCR assay, epidermal growth factor (EGF), transforming growth factor-α (TGF-α) and heparin-binding epidermal growth factor-like growth factor (HB-EGF) have been demonstrated to be capable of inducing ER mRNA expression significantly in cultured ovarian granulosa cells from preovulatory follicle (F1) in a time-dependent manner. The expression of epiregulin reached the maximum at 4 h and was sustained at 24 h post-treatment. Moreover, phorbol 12-myristate 13-acetate (PMA), a potent protein kinase C (PKC) activator, could also significantly induce epiregulin mRNA expression in a dose-dependent manner, suggesting that PKC (or PKC-activated) signaling pathway may be involved in controlling ER expression in the chicken ovary. These findings suggest that ER is a potential paracrine/autocrine factor involved in controlling ovarian development and its expression is regulated by local ovarian factors including EGFR ligands from chicken ovary.

Key Words: Epiregulin, Chicken, Ovary

893 Effects of different cryopreservation methods on the glyocalyx of chicken spermatozoa. J. Pelaez and J. A. Long*, *Beltsville Agricultural Research Center*, *Beltsville*.

The carbohydrate-rich zone on the sperm surface is essential for inmunoprotection in the female tract and early gamete interactions. We recently have shown the glycocalyx of chicken sperm to be extensively sialylated and contain residues of mannose, glucose, galactose, fucose, N-acetyl-galactosamine, N-acetyl-glucosamine and N-acetyl-lactosamine. Our objective here was to evaluate the effects of cryopreservation on the sperm glycocalyx. Semen was pooled from 6 roosters, diluted 1:1 (Lakes pre-freeze diluent), cooled to 5°C and aliquoted for cryopreservation using 6% DMA, 11% DMSO or 11% glycerol. For the DMA method, semen was equilibrated for 1 min with DMA and rapidly frozen by dropping 25 µl aliquots into liquid nitrogen. For the DMSO and glycerol methods, semen was equilibrated for either 1 min (DMSO) or 20 min (glycerol), loaded into 0.25 ml straws and frozen (5 to -35°C, 7°C/min; -35 to -140°C, 20°C/min; nitrogen plunge). Thawed (rapid, DMA; moderate, DMSO, glycerol) semen was stained with 1 of 12 FITC-conjugated lectins (100 µg/mL; 30 min; 25°C; $100x10^6$ cells/mL). Samples counterstained with PI were assessed by flow cytometry. On the day of cryopreservation, aliquots of fresh semen were stained with the panel of lectins and PI. For each lectin, the Mean Fluorescence Intensity (MnFI) of live sperm was compared among fresh and frozen/thawed (fr/th) treatments (n=5 replicates). For the majority of lectins (10/12), the MnFI was higher ($P<0.05$) for fr/th than fresh sperm. Exceptions included lectins specific for sialic acid and α-fucose, where DMSO and glycerol treatments, respectively, had MnFI similar ($P>0.05$) to fresh sperm. Among the fr/th treatments, the MnFI of sperm cryopreserved with DMSO was higher ($P<0.05$) for 4/10 lectins, including those specific for N-acetyl-lactosamine and N-acetyl-glucosamine. These data indicate that surface carbohydrates are altered during cryopreservation, and that cryoprotectant type and fr/th rates affect the degree of modification. While the specific functions of these glycoconjugates are not known, it is likely that the observed differences in fr/th sperm contribute to the reduced fertility of cryopreserved chicken semen.

894 Testicular development in meishan and commercial crossbred prepubertal boars. J. J. Ford*, *U.S. Meat Animal Research Center*, *Clay Center, NE*.

Total daily sperm production and testicular size of adult boars increase in proportion to the number of Sertoli cells within the testis. Meishan

(MS) boars experience puberty at a younger age than commercial crossbred (CB) boars in association with earlier cessation of Sertoli cell proliferation and smaller postpubertal testicular size. The objectives of the current study were 1) to define changes in the production of anti-Mullerian hormone (AMH) and p27kip1, markers of Sertoli cell differentiation, in prepubertal MS and CB boars (n > 3/breed/d), and 2) to relate these changes with the pubertal expansion of the seminiferous tubules. Presence of AMH and p27kip1 were assessed by immunohistochemistry and densitometric analyses using a Bioquant Nova color imaging system. Testicular weights were similar (P>0.10) in MS and CB boars at 7, 28 and 49 d of age although CB boars had greater (P<0.01) body weight at these ages. Testes weights of MS increased more rapidly than in CB after 49 d of age and were greater (p<0.02) at 70, 91 and 112 d of age. Diameter of seminiferous tubules increased (P<0.01) at a younger age and to a greater extent in MS than in CB boars. Relative amount of AMH, a product of less mature Sertoli cells, increased in both breeds from 7 to 28 d. AMH then declined thereafter at a more rapid rate (P<0.001) in MS than in CB boars and was nearly absent at 70 d in MS and at 112 d in CB boars. Seminiferous tubules containing p27kip1 were first detected at 28 d in some MS and at 70 d in some CB boars (P<0.01) and increased in both breeds through 112 d. The earlier onset of pubertal development in MS boars was characterized by expansion of seminiferous tubules at a younger age in association with a more rapid decline in AMH production and an earlier increase in p27kip1, indicative of an earlier onset of Sertoli cell differentiation in MS relative to CB boars.

Key Words: Boar, Testis, Puberty

895 Transcript profiling of testes from boars divergently selected for testosterone production. M. S. Ashwell*, S. Druyan, C. M. Ashwell, and J. P. Cassady, *North Carolina State University*, *Raleigh*.

The objective of this research is to identify changes at the gene level associated with 10 generations of divergent selection for testosterone production in response to a GnRH challenge. After ten generations of selection, average testosterone levels were 75 and 200 ng/ml for the low and high lines, respectively. Lines were subsequently maintained using random selection. Testicles from five boars from each line in generation 21 were collected at 1, 30, and 120 days of age. Tissues were snap frozen in liquid nitrogen and stored at -80°C for transcript profiling using a 13,297-oligonucleotide swine microarray. RNA was extracted from all boars from both lines, pooled by age and line, fluorescently labeled with either Cy3 or Cy5, and hybridized to the arrays. Hybridization intensity data were LOWESS-normalized within and across the arrays and analyzed using ANOVA. In total, 25 genes showed differential expression with a false discovery rate of 8%. Ten of these 25 genes have no known function or characterization. Most of these 25 genes were found to be differentially expressed across ages and by the interaction of age and line. The ability to detect differences in gene expression between the lines that are related to the observed differences in testosterone level is in part a result of the degree of replication in the array. Two genes associated with steroid biosynthesis, steroidogenic acute regulatory protein and aromatase type II, were shown to be differentially expressed. Validation of these findings is underway using real-time PCR methods.

Key Words: Swine, Gene Expression, Steroid Biosynthesis

Production, Management & the Environment - Livestock and Poultry: The Evolving National Animal Identification System

896 The Canadian Livestock Traceability System. J. M. Stitt*, *Canadian Cattle Identification Agency*, *Calgary, Alberta, Canada*.

The Canadian Cattle Identification Agency (CCIA) is a not-for-profit National Agency, incorporated in 1998, and led by a Board of Directors, representing all sectors of the livestock industry. The mandate of CCIA is to establish and maintain an efficient Animal Health and Food Safety Identification and Traceability system. With the program fully implemented on July 1, 2002, CCIA has been successfully established as a leader in Animal Identification and Traceability. Guided by National Standards and operating Under the ID Regulations within the Federal Health of Animals Act, the CCIA, in partnership with the Canadian Food Inspection Agency (CFIA), has achieved 98-100% compliance nationally. The CCIA system provides multi-species services and currently houses the beef, dairy, bison and sheep trace back data and is offering services to pork and poultry. In 2003, the Canadian cattle industry committed to the transition from barcode dangle tags to Radio Frequency Identification Devices (RFID). The program is industry supported, sustainable and has proven invaluable through the recent BSE investigations. The Canadian System incorporates the 3 Key Pillars for Traceability; Animal Identification, Premises Identification and Animal Movement. Additionally, it offers Value-Added services, as required by industry. Age Verification is one example of a Value-Added service assisting in assuring market access. The program implementation was not easy and as we expand on the national infrastructure we continue to face challenges. The successful implementation and commitment to ongoing development of the National Livestock Traceability System can be attributed to:

- support from all sectors of the cattle industry across Canada

- national communications strategy

- shared industry/government partnership

- commitment for industry to lead the program

- commitment to keep the program user-friendly, cost-effective and scaleable

- the unfortunate but timely global Animal Health and Food Safety issues.

CCIA is committed to ensuring that all program components continue to meet and exceed evolving Domestic and International requirements.

Key Words: Traceability, Identification, CCIA

897 Issues surrounding existing and potentially disruptive RFID technologies for the identification of food producing animals. D. A. Blasi*, *Kansas State University*, *Manhattan*.

The primary objective of a voluntary US National Animal Identification System (NAIS) when fully operational is the integration of the

regulatory capacity of animal health. Several species working groups (bison, cattle and equine) initially recommended the implementation of low frequency (LF) radio-frequency identification (RFID) technology based on internationally recognized ISO 11784/11785 standards in order to achieve the goal of a 48-hour trace back when the system is fully operational. LF technology has been manufactured, on an industrial basis, since the mid 1990s and is used in multiple animal identification systems worldwide. The subsequent adoption of a technology-neutral position by USDA to ensure a level playing field for all types of technologies has created a surge of startup companies promising new technologies that are readily available off the shelf and capable of offering improved solutions to existing LF technology at a fraction of the cost. Emerging technologies have not been validated under a variety of livestock environments for transponder retention and read range performance. Moreover, performance standards do not exist for any existing technology at the present time. The USDA has recognized the importance of standardization within NAIS for ensuring compatibility across vendors and international recognition of identification technologies used within the system. The USDA has subsequently endorsed the use of ISO 11784/11785 standards for livestock producers who elect to use RFID in the NAIS with the proviso for establishment of voluntary consensus standards for emerging technologies in the US through the American National Standards Institute (ANSI). This institute could facilitate the acceptance of standards for emerging technologies at the international level. All technologies must be fairly and consistently evaluated in transparent testing environments. The development of this process is essential for ensuring that NAIS– approved technologies can achieve the primary objective while providing the most economical means of individual identification for the livestock producer.

Key Words: Animal Identification, Technology

Ruminant Nutrition: Intake Behavior/Acidosis/Metabolism - Dairy

898 Feed sorting in dairy cattle: Effects of repeated acidosis challenges. T. J. DeVries*[1], F. Dohme[2], and K. A. Beauchemin[1], [1]*Agriculture and Agri-Food Canada*, *Lethbridge, AB*, [2]*Agroscope Liebefeld-Posieux*, *Posieux, Switzerland*.

An experiment was conducted to determine if dietary forage content influences feed sorting by dairy cattle and whether this changes during acidosis. Eight ruminally cannulated cows were assigned to either a high (HF, 60% forage) or low forage (LF, 45% forage) diet (DM basis). Following a 2 wk adaptation, cows were exposed to 2 repeated acidosis challenges (2 periods) separated by 14 d. The challenge consisted of restricting feed to 50% of ad libitum intake for 24 h, followed by a meal of 4 kg of ground barley/wheat before ad libitum allocation of TMR (challenge day). Ruminal pH was measured continuously. Feed and orts were sampled for 2 baseline days, on the challenge day, and 1, 2 and 5 d after the challenge day for each animal and subjected to particle size analysis. The separator contained three screens (18, 9, and 1.18 mm) and a bottom pan to determine the proportion of long, medium, short and fine particles, respectively. Sorting activity was calculated as actual intake as a percentage of predicted intake. To determine if sorting occurred, each fraction was tested for a difference from 100%. The bout of acidosis following the challenge was more severe ($P<0.05$) in period 2 and was greatest ($P<0.05$) for cows fed LF. Cows fed LF sorted ($P<0.01$) for medium particles (107%), but against long (92%), short (98%), and fine particles (90%). Cows fed HF sorted ($P<0.01$) for medium (103%) and short particles (102%), but against long particles (89%). Overall, sorting for medium particles and against fine particles were greater ($P<0.01$) on the LF diet. Diet × period × day interactions ($P<0.01$) indicated that during period 2, LF cows decreased their sorting against long particles and increased sorting against short and fine particles on the day after the challenge when acidosis was most severe. These results suggest that the proportion of forage in the diet affects how dairy cows sort their feed. Furthermore, cows experiencing severe acidosis preferentially sort their feed to attenuate the effects of this disease.

Key Words: Acidosis, Sorting, Forage

899 Severity of ruminal acidosis increases with repeated bouts particularly when cows are fed low forage diets. F. Dohme*[1], T. J. DeVries[2], K. A. Beauchemin[2], K. M. Krause[3], and K. S. Schwartzkopf-Genswein[2], [1]*Agroscope Liebefeld-Posieux, Research Station ALP*, *Posieux, Switzerland*, [2]*Agriculture and Agri-Food Canada*, *Lethbridge, AB*, [3]*West Virginia University*, *Morgantown*.

An experiment was conducted to determine the response of cows to repeated acidosis challenges. Eight lactating ruminally cannulated cows were assigned to one of 2 diets (DM basis): high fiber (HF, 60% forage) or low fiber (LF, 45% forage). Following a 2-wk adaptation, cows were exposed to 3 acidosis challenges (3 periods), each separated by 14 d. The challenge consisted of restricting feed to 50% of *ad libitum* intake for 24 h, followed by a meal of 4 kg of ground barley/wheat before *ad libitum* allocation of TMR (challenge day). Ruminal pH was measured continuously. Total acidosis was defined as pH < 5.8, moderate acidosis as pH < 5.5, and severe acidosis as pH < 5.2. The entire grain allotment was consumed by all cows in Period 1, 6 cows in Period 2, and only 3 cows in Period 3. Despite reduced grain intake in each period, the severity of acidosis increased ($P < 0.05$) in each period: mean pH dropped by 0.13 pH units, minimum pH dropped by 0.20 units, and duration of total acidosis increased by 2 h/d. Furthermore, the severity of acidosis following the challenge was greater for cows fed LF compared to HF, as evidenced by diet × period interactions ($P < 0.05$) for area under the total acidosis threshold, area under the moderate acidosis threshold, and duration of acute acidosis. Those variables indicated that the severity of acidosis increased from Period 1 to 3 by 3 to 6-fold for cows fed LF and by 2 to 4-fold for cows fed HF. This study indicates that cows become more prone to acidosis over time even though they alter feed intake to avoid acidosis. The severity of each subsequent bout of acidosis increases, especially when cows are fed diets low in physically effective fiber. Therefore, a bout of acidosis that occurs due to improper feed delivery or poor diet formulation can have long-term consequences on cow health and productivity.

Key Words: Acidosis, Ruminal pH, Physically Effective Fiber

900 Grain-induced subacute ruminal acidosis (SARA) stimulates translocation of lipopolysaccharide (LPS) into the blood, and increases acute phase proteins in bovine plasma and milk. E. Khafipoor*, D. O. Krause, and J. C. Plaizier, *University of Manitoba*, *Winnipeg, MB, Canada*.

The effects of grain-induced subacute ruminal acidosis (SARA) on translocation of lipopolysaccharide (LPS) into the blood, and acute phase proteins in plasma and milk were determined in lactating Holstein cows. Between wk 1 and 5 of two successive 6 wk periods, cows received total mixed ration (TMR) ad-libitum with a forage-to-concentrate (F:C) ratio of 50:50. In wk 6 of both periods, SARA was induced by replacing, on average, 21% of DM of the TMR with pellets containing 50% wheat and 50% barley, resulting in a F:C ratio of 29:71. Rumen pH was monitored continuously using in-dwelling pH probes. Rumen fluid and peripheral blood samples were collected 15 min before feeding and 6 and 12 h after feeding for two days during wk 5 (control) and 6 (SARA). Induction of SARA significantly reduced average daily pH from 6.17 to 5.97 and increased the duration of rumen pH below pH 5.6 to above 180 min/d, which was taken as the threshold for SARA. SARA also reduced dry matter intake (16.5 vs. 19 kg/d), milk yield (28 vs. 31.2 kg/d), and milk fat (2.82 vs. 3.41%, 0.79 vs. 0.99 kg/d), but increased milk protein percentage (3.58 vs. 3.28 %) without affecting milk protein yield (0.94 vs. 0.98 kg/d). Concentrations of free-LPS in rumen fluid and blood plasma were also increased by SARA. In response to plasma LPS, blood concentrations of the acute phase proteins serum amyloid-A (SAA), haptoglobin (Hp), and LPS-binding protein (LBP) were increased during SARA. The data suggest that grain-induced SARA increases lysis of Gram-negative bacteria and translocation of LPS into the peripheral blood, and that this triggers an immune response.

Table 1. Rumen LPS, plasma LPS and acute phase proteins during SARA

Item	Control	SARA	P-value
Rumen LPS, EU/ml	28,400	107,700	0.005
Plasma LPS, EU/ml	<0.05	0.52	0.004
LBP in plasma, µg/ml	18.0	53.0	0.018
LBP in milk, µg/ml	3.00	6.94	0.02
Hp in plasma, µg/ml	0.0	484.0	0.001
SAA in plasma, µg/ml	77.6	218.6	0.01

Key Words: Subacute Ruminal Acidosis, Plasma LPS, Acute Phase Response

901 Induction of subacute ruminal acidosis (SARA) by replacing alfalfa hay with alfalfa pellets does not stimulate inflammatory response in lactating dairy cows. E. Khafipoor*, D. O. Krause, and J. C. Plaizier, *University of Manitoba*, *Winnipeg, MB, Canada*.

To determine if SARA induced by feeding diets with a short particle length results in similar increases in free bacterial lipopolysaccharide endotoxin (LPS) in rumen fluid and peripheral blood than grain-induced SARA, four rumen fistulated and four non-rumen fistulated dairy cows were used in a 6 wk study. During wk 1, cows received a diet containing 50% DM as concentrate and 50% DM chopped alfalfa hay. Between wk 2 and wk 6, alfalfa hay was gradually replaced with alfalfa pellets. Rumen fluid and peripheral blood were sampled before and 8 h after feeding. Rumen pH was monitored continuously in the rumen fistulated cows. Replacing alfalfa hay with alfalfa pellets reduced average daily pH (6.35 vs. 5.78), milk yield (35.9 vs. 32.7 kg/d) and milk fat (3.22 vs. 2.32%) and increased milk protein (3.04 to 3.80 %) and rumen VFA (90 to 122 mM). SARA was induced from wk 3 onwards when the rumen pH was lower than 5.6 for more than 180 min/d. Similar to grain-induced SARA, in this study SARA increased rumen LPS. However, this increase was not accompanied by feed intake depression, and increases in LPS and in the acute phase proteins serum amyloid-A (SAA), haptoglobin (Hp), and LPS-binding protein (LBP), in peripheral blood. This suggests that factors other than low rumen pH and increased free rumen LPS are responsible for the inflammatory response seen during grain-induced SARA. These factors might include rumen bypass starch, which has potential to alter microbiota and LPS release in the hind gut.

Table 1.

Item	Wk 1	2	3	4	5	6	P-value
Diet							
Alfalfa hay, % DM	50	42	34	26	18	10	
Alfalfa pellets, % DM	0	8	16	24	32	40	
DMI, kg/d	16.9^{c}	19.5^{b}	21.9^{a}	22.1^{a}	23.5^{a}	23.7^{a}	<0.01
Rumen parameters							
Time < pH 5.6, min/d	112^{c}	174^{c}	268^{b}	558^{a}	510^{a}	447^{ab}	<0.04
Rumen LPS, EU/ml	38,900^{b}	38,000^{b}	34,600^{b}	61,700^{ab}	120,200^{a}	162,200^{a}	<0.01
Blood parameters							
LPS, EU/mL	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	
LBP, µg/ml	7.2	4.2	3.4	3.9	5.1	2.6	0.09
Hp, µg/ml	56^{a}	34^{ab}	27^{b}	28^{b}	21^{b}	12^{c}	<0.01
SAA, µg/ml	23.1^{a}	12.3^{ab}	7.8^{b}	12.3^{ab}	9.6^{b}	6.9^{b}	<0.01

Key Words: Subacute Ruminal Acidosis, Plasma LPS, Acute Phase Response

902 Particle analysis of swallowed hay boluses varying in chop length. I. Schadt*[1], M. Caccamo[1], J. D. Ferguson[2], G. Azzaro[1], R. Petriglieri[1], P. Van Soest[3], and G. Licitra[1,4], [1]*CoRFiLaC, Regione Siciliana*, *Ragusa, Italy*, [2]*University of Pennsylvania, School of Veterinary Medicine*, *Kennett Square*, [3]*Cornell University*, *Ithaca, NY*, [4]*D.A.C.P.A. University of Catania*, *Catania, Italy*.

Sufficient long fiber is critical in dairy rations to maintain normal rumen function. Effective NDF has been defined as material retained on a 1.18 mm sieve. Mertens further refined this to describe physically effective NDF as material that maintains acceptable rumination and milk fat content. Dietary particle size is altered as a cow chews to process feed material for swallowing. This project examined the long particle distribution in a swallowed bolus from hay of variable lengths. Three nonlactating, rumen fistulated cows, adapted to Loietto grass hay, were held off feed for 12 hours, rumens evacuated, and offered 0.25 kg of long or chopped hay. Swallowed boli were manually retrieved from the reticulo-rumen at the esophageal orifice. Treatments were as follows: 1) long hay, 2) hay cut to 5 cm lengths, 3) chopped hay retained on a 1.91 cm screen, 4) chopped hay which passed a 1.91 cm screen but retained on a .787 cm screen, and 5) chopped hay passing a .787 cm screen but retained on a .127 cm screen. Long particles in hay treatments and boli were defined as those retained on a 1.6 mm screen. Mean long particle size and distribution in hay treatments and boli were defined after Licitra et. al. (J. Anim. Sci. 83:supplement 1, 252). Mean long particle sizes (mm, (sd)) for treatments were as follows (superscripts differ by p<.05): 1) long hay, not determined, 2) 46.2^{a} (.6), 3) 51.0^{b} (.9), 4) 25.8^{c} (.3), and 5) 9.8^{d} (.1). Mean long particle

bolus sizes (mm, (sd)) by treatments were as follows (superscripts differ by p<.05):1) 9.1[a] (.1), 2) 9.1[a] (.1), 3) 9.5[b] (.1), 4) 9.0[a] (.1), and 5) 7.8[c] (.1). Chewing altered particle distribution so hay particles which were retained above a screen size of .787 cm were rather similar in mean size and distribution when swallowed. Dietary hay particles smaller than .787 cm were smaller in the swallowed bolus.

Key Words: Hay Particles, Bolus Particles, Dairy Cattle

903 Rumen function and lameness in pasture based dairy cows of the South Island of New Zealand. J. Gibbs*, J. Laporte-Uribe, C. Trotter, and J. Noel, *Dairy Science Group, Agriculture and Life Sciences, Lincoln University*, *Canterbury, New Zealand*.

Dairying in the South Island (SI) of New Zealand is pasture based, commonly with large herds (>600) and intensive pasture management with high feed quality across the lactation season. Lameness in this system is a dominant health and welfare concern, and a common industry explanation is sub-clinical laminitis due to the high sugar and low fibre of the pastures. This project sought to establish the incidence and profile of lameness in SI herds, and the characteristics of rumen function and any role it has in lameness, in SI systems. All lameness on 43 representative SI farms (>32000 cows) in 2005/06 was recorded. All cases had affected claw, diagnosis, and treatment recorded in a diary. Monthly pasture samples were obtained. Detailed ancillary information on farm management, infrastructure, nutrition, production, reproduction and lameness reduction strategies was obtained. Five cows in one herd were rumenally fistulated. For 96 h periods across the season, rumen pH and temperature were logged every 15s via indwelling probes. Rumen samples were obtained twice weekly for metabolite and microbiota assessment. The mean lameness incidence recorded was >22%. Pasture quality was very high with little variation across the season. Lameness was positively associated with herd size and pasture quality, but not infertility. Recorded pH values were low: up to 80, 20 and 10% of some trial periods were <6.0, <5.5, and <5.0, respectively. A daily pH trough of 5.0-5.5 was recorded in most cows across the season. Lactic acid was absent or <1 mmol/L, while volatile fatty acid profiles were typical of grass fed ruminants. Microbial profiles suggested major sub-populations changed little across the season. No clinical or production observations suggested rumen dysfunction. Conclusions: The incidence of lameness in 2005/06 in the SI appears higher than previously reported in similar systems in NZ and Australia. Several potential regional influences are suggested: large herd size, nutrition, and management. Rumen function in high production SI cows appears atypical, with marked diurnal pH trough and flux, yet stable metabolite production and microbiota.

Key Words: Dairy Pasture, Lameness, Rumen pH

904 Effect of lifecycle stage of dairy cattle on serum mineral concentrations. D. R. Bremmer[1], R. H. Schulte[2], and M. T. Socha*[3], [1]*Vita Plus Corporation*, *Madison, WI*, [2]*Modified Genetics*, *Marshfield, WI*, [3]*Zinpro Corporation*, *Eden Prairie, MN*.

Blood samples were obtained from Holstein cows on a commercial dairy to determine lifecycle stage effect on serum mineral concentrations. Samples, collected on 2 d, approximately 8 wk apart, were obtained from 40 cows in first 2 wk of dry period (Dry), 43 cows less than 2 wk prior to calving (Prefresh) and 40 cows in first wk of lactation (Postfresh). Effects included in data analysis model were sampling time and lifecycle stage, with significant period effects noted at P≤0.05. Serum concentrations of non-heme Fe and Mg were lower, Postfresh than in Dry and Prefresh periods (121.0 vs. 156.9, 158.0 µg/dL; 21.7 vs. 23.3, 23.5 µg/mL), while serum concentrations of Mo and Cu were higher, Postfresh than in Dry and Prefresh periods (24.9 vs. 4.9, 4.8 ng/mL; 0.84 vs. 0.70, 0.66 µg/mL). More Postfresh cows had less than adequate serum concentrations of non-heme Fe and Mg than Dry and Prefresh cows (42.5 vs. 2.5, 2.3%; 37.5 vs. 7.5, 7.0%), while more Prefresh and Dry Cows had less than adequate serum concentrations of Mo and Cu than Postfresh cows (100, 100 vs. 7.5%; 22.5, 32.6 vs. 2.5%). Serum Mn concentrations were higher in the Prefresh period than in the Dry period (1.48 vs. 1.20 ng/mL, P<0.05), with 82.5, 58.1 and 75.0% of Dry, Prefresh and Postfresh Cows having less than adequate Mn serum concentrations. Serum Co concentrations were highest, Prefresh, followed by Dry and Postfresh periods (1.18, 0.91 and 0.74 ng/mL). More Dry and Postfresh cows had less than adequate serum Co concentrations than Prefresh cows (15.0, 15.0 vs. 0.0%). Serum Zn concentrations were highest in Dry period, followed by Prefresh and Postfresh periods (1.77 vs. 1.65 vs. 1.34 µg/mL) while serum Se concentrations were highest, Postfresh, followed by Dry and Prefresh periods (103.7 vs. 91.8 vs. 82.4 ng/mL). All cows had adequate serum Se concentrations and only 2.5% of Postfresh cows had less than adequate serum Zn concentrations. Results of this survey indicate that cows on this dairy are most prone to Fe and Mg deficiencies, Postfresh, Cu and Mo deficiencies in Dry and Prefresh periods and Mn deficiencies in Dry, Prefresh and Postfresh periods.

Key Words: Serum, Dairy Cattle, Minerals

905 Phosphorus balance in dairy cows during lactation. J. A. Elizondo Salazar*[1], D. B. Beegle[1], J. D. Ferguson[2], and Z. Wu[2], [1]*Pennsylvania State University*, *University Park*, [2]*University of Pennsylvania*, *Kennett Square*.

Phosphorus balance in lactating cows was determined. Thirty multiparous Holsteins were fed 0.32% P during the dry period and assigned to one of the following three dietary treatments for the subsequent lactation: 0.36% P throughout the lactation (0.36-0.36-0.36), 0.36% P for 30 wk followed by 0.29% P for 14 wk (0.36-0.36-0.29), and 0.43% P for the first 10 wk, 0.36% P for the second 10 wk, and 0.29% P for the last 14 wk (0.43-0.36-0.29). Phosphorus balance was determined during wk -4 to -1, 9 to 13, 19 to 23, and 38 to 42 of lactation as intake P - fecal P - urinary P - milk P, when appropriate. While not different among treatment groups, the balance was negative for wk -4 to -1 and 9 to 13, became positive by wk 19 to 23, and showed a clear deposition during wk 38 to 42 for all groups. Consistent with the changes in P balance, plasma osteocalcin, a bone formation maker, increased during most of lactation, averaging 6.9, 9.4, 12.0, and 5.9 ng/ml for all groups, and plasma pyridinolin, a bone resorption marker, decreased, averaging 3.1, 2.8, 2.6 and 2.4 pg/ml, for wk -4 to -1, 9 to 13, 19 to 23, and 38 to 42, respectively. Rib bone P averaged 10.7 and 12.3% for all groups during wk -4 to -1 and 38 to 42, respectively, also consistent with the P balance data. Results suggest that cows mobilized P from bone during the dry period toward parturition and during early lactation, and restored P toward the end of lactation; this pattern of P metabolism did not differ when different amounts of P were fed. (Partially funded by Pennsylvania Department of Agriculture)

Table 1. Phosphorus balance (g/d)

Week	0.36-0.36-0.36	0.36-0.36-0.29	0.43-0.36-0.29	SEM	*P* Constant vs. varied P[1]	P changed once vs. twice[2]
-1 to -4[4]	-7.9	-7.9	-7.9	...	...	...
9 to 13	-3.0	-4.4	-0.5	4.3	0.55	0.82
19 to 23	0.6	1.2	3.9	3.8	0.52	0.92
38 to 42	4.4	7.1	8.6	3.1	0.49	0.57

[1]0.36-0.36-0.36 vs. 0.36-0.36-0.29 and 0.43-0.36-0.29. [2]0.36-0.36-0.29 vs. 0.43-0.36-0.29. [3]All groups received 0.32% P during the dry period.

Key Words: Dairy Cows, Phosphorus Requirement, Bone Phosphorus

906 Effect of 2-hydroxy-4-(methylthio) butanoic acid isopropyl ester on milk production and composition of high yielding lactating Holstein dairy cows. R. H. Phipps*[1], A. K. Jones[1], C. K. Reynolds[1], D. I. Givens[1], P-A. Geraert[2], and C. Richard[2], [1]*University of Reading*, *Reading, UK*, [2]*Adisseo*, *Commentary, France.*

Sixteen-multiparous, high yielding Holstein cows (72 ± 16 DIM; 45.0 ± 2.96 kg milk/d) were used, in a 4 × 4 Latin square design to determine the effect of 2-hydroxy-4-(methylthio) butanoic acid isopropyl ester (Metasmart®; 4.2 g/kg concentrate DM) and dietary crude protein (CP) content (low: 14.7 % vs. standard: 16.9 %, DM fed) on milk yield and composition in a 2 × 2 factorial design. All cows received ad libitum a TMR with a 1:1 forage to concentrate ratio (DM basis) and diets contained an estimated metabolizable lysine and methionine content of 6.7 and 1.8 % of metabolisable protein, respectively. Data for DM intake (DMI), milk yield and composition were obtained in wk 4 of each period. No significant treatment effects on DMI (24.7 ± 0.52 kg/d) were noted. There was a significant interaction between dietary CP and Metasmart® for milk yield, 3.5% fat-corrected milk (FCM) yield and yield of milk protein. Metasmart® increased milk yield by 0.5 kg/d (P < 0.05), 3.5% FCM yield by 1.3 kg/d (P < 0.05) and milk protein yield by 65 g/cow/d (P < 0.001) with 16.9 % dietary CP, but had no effect in the 14.7 % CP diet. Feeding Metasmart® increased milk protein content by 1.1 g protein/kg (P < 0.001), with values of 1.3 and 0.8 g/kg noted for standard and low CP diets, respectively. Although numerically higher at both levels of dietary CP, there was no significant effect of Metasmart® on milk fat concentration. In conclusion, feeding Metasmart® increased 3.5 % FCM yield and milk protein content after only 3 wks of supplementation. In addition, the effect of Metasmart® on milk protein and 3.5 %FCM yield was only observed at the standard level of dietary CP, suggesting other factors limited the response to Metasmart® when dietary protein supply was restricted.

Key Words: Dairy Cows, Milk Production, Amino Acid Supplement

907 Transport of 2-hydroxy-4-methyl-thio-butanoic isopropyl ester (HMBi) across rumen epithelium *in vitro*. W. Heimbeck*[1] and G. Breves[2], [1]*Degussa GmbH*, *Hanau, Germany*, [2]*Institute for Physiology, School of Veterinary Medicine*, *Hannover, Germany*.

Objective was to evaluate the potential of rumen epithelium to transport HMBi using Ussing chambers. Rumen tissues were obtained from a nearby slaughter house, stripped from the muscle layer, placed in buffer and gassed with 95:5 O2:CO2 before mounting. Two levels of HMBi (0.78 and 1.56 mg per ml) and 2 incubation times (120 and 180 min) were used in 12 chambers with 3 replicates with an exposed surface of 2 cm2. Four separate experiments were conducted (n= 48). Concentrations of HMBi and methionine hydroxy analog (HMB) were measured by HPLC in mucosal and serosal buffers. Data are expressed as % of added HMBi. Differences were assessed with GLM of SAS. Model included terms for experimental day, HMBi level, incubation time, sampling side and interactions. Adding the HMBi-buffer mixture to the mucosal side caused an immediate release of HMB (mean = 6.3%). Breakdown of HMBi to HMB at 0 time may be due to hydrolysis reactions in buffer or reactions at epithelial surface. A small but consistent amount of HMBi (mean 0.58%) was transferred to serosal buffer. A larger amount of HMB (8.94%, P<.01) was also isolated (about 0.06% per minute). Evidence of HMB in serosal buffer may indicate HMBi transfer and subsequent hydrolysis. Increasing dose elevated quantity but decreased % of dose appearing as HMB on the serosal side (10.54% and 7.33%, P<.01). Increasing incubation time increased the amount of HMB in the mucosal side buffer (34.0% at 120 min versus 43.4% at 180 min, P<.01) and decreased the amount of HMBi (37.9% at 120 min versus 28.1% at 180 min, P<.01). Small differences among experiments for recovery of HMB and HMBi were observed (MSD= 4.18 and 1.84 mucosal; 4.29 and 0.28 serosal). These data indicate that, if HMBi is transported actively, the system may be readily saturated. Alternatively, HMBi may move across the epithelium by diffusion. From these *in vitro* experiments, there is no evidence that rapid increases in blood HMB in response to HMBi intake are due to ruminal absorption.

Key Words: HMBi, Rumen Epithelium

908 Responses of rumen and blood metabolites of Holstein dairy cows to propylene glycol during frequent feeding. Y.-H. Chung*, C. M. Martinez, N. E. Brown, T. W. Cassidy, and G. A. Varga, *Dairy and Animal Science, Pennsylvania State University*, *University Park*.

The objective of the present experiment was to study the metabolic adaptation of Holstein dairy cows in response to propylene glycol (PG) when provided under different methods of delivery. By providing the same amount of pure PG, methods of delivery of PG assessed were: (1) control: no PG, (2) oral-drench: 226.8 ml (8 oz) of liquid PG (100% purity) oral drenched, (3) rumen-drench: 348.9g of dry PG (65% purity) drenched via rumen cannula, and (4) mixed: 348.9g of dry PG mixed into the TMR. Eight multiparous rumen cannulated Holstein dairy cows (DIM = 204 ± 104 SD) were fed PG for 4 d in a replicated 4 × 4 Latin square design with 14-d periods. On the last day of each period, cows were fed every 2 h to minimize postprandial effects. Blood was serially sampled from the jugular vein immediately before and for 4 h after PG administration. Rumen contents were serially sampled hourly for 4 h via the rumen cannula. Feed intake and milk yield were not affected by PG. Percentage of milk lactose was significantly increased by PG, across all methods tested in this experiment. The concentration of acetate was significantly decreased and propionate was significantly increased by PG (21.9 vs. 24.4 mol/100mol for control vs. PG treatments), regardless of delivery method. Concentration of butyrate was significantly decreased by PG

drench, either via oral or ruminal drench. Production of total VFA however was not statistically altered by PG. Serum insulin peaked significantly higher and more rapidly for cows receiving PG via drenching but not as a part of the TMR. Plasma glucose, however, tended to peak higher and more rapidly for cows receiving PG, regardless of delivery method. Results showed that rumen and blood metabolites responded similarly to liquid or dry PG drench indicating that top dressing dry PG is as effective as oral drenching liquid PG. Feeding dry PG as a part of the TMR during frequent feeding significantly altered the rumen profile toward a more glucogenic environment without stimulation of insulin.

909 Glucose minimal modeling in lactating dairy cows. R. C. Boston*[1], J. R. Roche[2], and P. J. Moate[1], [1]*University of Pennsylvania*, *Kennett Square*, [2]*University of Tasmania*, *Burnie, Tas, Australia*.

Quantification of the kinetics of glucose metabolism in lactating dairy cows may have application in elucidating the factors that control milk production or are involved in the etiology of metabolic diseases such as ketosis, fatty liver disease and downer-cow syndrome. For more than twenty years, researchers in the field of diabetes have used the Intravenous Glucose Tolerance Test (IVGTT) in humans, coupled with Bergman's non-linear "minimal model" (MinMod) to derive a rich set of parameters to describe the interaction between blood glucose and insulin. These parameters include: Glucose effectiveness (S_g), a first order rate constant describing its disappearance from blood, and Insulin sensitivity (S_I), which represents the capacity of insulin to promote the disposal of glucose from blood. Although more than 700 publications in human research have used the well-documented and carefully standardized IVGTT protocol and minimal modeling methodology, few studies in ruminant nutrition have used this approach. This investigation examined the capability of the standard (no insulin injection) IVGTT coupled with minimal modeling to obtain identified estimates of S_g and S_I in lactating cows. Ten lactating cows of diverse genetic origin and fed a wide range of diets, underwent a standard IVGTT with blood sampled at 0, 2, 4, 6, 8, 10, 12, 15, 18, 20, 23, 26, 30, 35, 40, 50, 60, 90, 120, 150, 180, 210, and 240 minutes. Plasma was measured for glucose and insulin. Minimal model analysis was conducted using MINMOD Millennium. The median, minimum and maximum estimates for S_g [% min^{-1}] were: 2.25, 1.12 and 3.44 and for S_I [10^{-4}(mU/L)$^{-1}$.min^{-1}], the corresponding estimates were 12.9, 8.7 and 17.1. In all individual cows, S_g and S_I were well identified with coefficients of variations less than 5%. The median estimate 2.25 for S_g is similar to the value of 2.2 reported for humans, but the median value of 12.9 for S_I in cows is surprisingly substantially higher than the value of 2.0 in humans. These findings suggest that glucose minimal modeling has great potential application in ruminant nutrition research.

Key Words: Glucose Effectiveness, Insulin Sensitivity, Minimal Model

Ruminant Nutrition: Lipid Supplementation

910 A decade of research developments in ruminant nutrition at the University of Wyoming. B. W. Hess*, *University of Wyoming*, *Laramie*.

Research efforts have focused on nutritional management practices to improve production efficiency of forage–fed ruminant animals, with primary emphasis on strategic supplementation regimens and secondary interest in alternative forage systems. The research program consists of three primary foci: 1) dietary lipids for ruminant animals; 2) protein nutrition of ruminant animals; and 3) the use of alternative forage crops and cropping methods in ruminant animal production systems. Interest in dietary lipids stems from the potential to alter fatty acid composition of food products derived from ruminants and the possibility to increase reproductive performance of ruminants through provision of supplemental vegetable oil. Investigations span from evaluating effects of supplemental lipids on site and extent of digestion to characterizing fate of fatty acids during metabolism and subsequent responses within various tissues and by the whole animal. Results of those endeavors suggest that vegetable oil may be added to forage–based diets at 3% of total DMI, tissue composition of fatty acids generally reflect fatty acids made available to the animal after ruminal biohydrogenation, and feeding cracked high–linoleate safflower seeds to beef cows during early lactation may have deleterious effects on reproduction and immune response by the suckling calf. The likelihood of livestock experiencing limited DMI in many range production systems has led to exploration of range management practices to enhance rangeland forage productivity and quality. Additionally, an interest in identifying specific nutrients involved with mediating various physiological responses within the animal has led to investigations centered on assessing essential AA status in ruminants fed limited amounts of roughage. An animal protein–based supplement has been developed to balance intestinal supply of essential AA in ruminants fed limited amounts of roughage. The research program is becoming more integrated as nutritional evaluations of rangeland forages indicate that strategic supplementation with lipids or protein may be warranted.

Key Words: Forages, Ruminants, Supplementation

911 Effect of dietary fish and soyoil supplementation on muscle fatty acid concentrations and oxidative lipid stability in beef cattle. D. A. Kenny*[1], J. P. Kelly[1], F. J. Monahan[1], and A. P. Moloney[2], [1]*University College Dublin*, *Dublin 4, Ireland*, [2]*Teagasc Grange Research Centre*, *Co. Meath, Ireland*.

The objective of this study was to examine level and duration of soyoil (SO) and fishoil (FO) supplementation on muscle fatty acid (FA) concentration and lipid oxidative stability in beef cattle. Young beef bulls (n=48) were blocked on age, bodyweight, and breed and individually offered ad libitum one of four isolipid and isonitrogenous diets for 100 days. All diets consisted of 10:90 (DM basis) straw:concentrate. The concentrates contained one of: (i) 6% SO (CON); (ii) 6% SO + 1% FO (FO1); (iii) 6% SO + 2% FO (FO2) or (iv) 8% palmitic acid for first 50 days and 6% SO + 2% FO for latter 50 days (FO2(50)). Palmitic acid was added to CON and FO1 to give 8% added lipid. The SO had 53% linoleic acid while the FO had 39%

EPA and 24% DHA. All diets were fortified with vitamin E. Following slaughter steaks were recovered from the M. longissimus dorsi (LD) and FA were analysed by GC. Lipid oxidative stability of LD was measured at 0, 24, and 72 h post cooking. The data were analysed using mixed models ANOVA with repeated measures as appropriate. Muscle concentrations of EPA and DHA were not different within FO treatments but were higher ($P < 0.001$) in all FO treatments compared with CON. Vaccenic acid (VA) the substrate for Δ-9 desaturase catalysed synthesis of c9, t11 CLA was higher in FO1 and FO2 compared with CON ($P < 0.01$) or FO2(50) ($P< 0.05$) but there was no difference ($P > 0.05$) between FO2(50) and CON. There was no effect ($P > 0.05$) of treatment on the concentration of c9, t11 CLA. The t10 c12 CLA isomer was higher in FO2 compared with the other treatments ($P < 0.05$). After 24 and 72 h post cooking, malondialdehyde (MDA) concentrations in CON were lower compared with the three fishoil treatments ($P < 0.01$). There was a tendency towards higher MDA in FO2 compared with FO1 at both 24 and 72h ($P = 0.08$). The lack of enhancement in c9, t11 CLA despite increases in tissue VA, suggest a possible direct inhibitory effect of ω-3 PUFA on Δ-9 desaturase activity. Furthermore, increasing ω-3 PUFA in the animals diet tended to reduce the oxidative stability of beef post cooking.

Key Words: Beef Cattle, CLA, Fatty Acids

912 Effects of feeding fresh and oxidized fat in the presence and absence of dietary antioxidant on lactation performance. M. Vazquez-Anon[1], G. Bowman*[1], T Hampton[1], P. Vazquez[2], T. Jenkins[3], and J. Nocek[4], [1]*Novus International*, *St Charles, MO*, [2]*Universidad de Santiago*, *Lugo, Spain*, [3]*Clemson University*, *Clemson, SC*, [4]*Spruce Haven Research*, *Union Springs, NY*.

The objective of the study was to evaluate the effect of feeding the dietary antioxidant AGRADO Plus® (AO; Novus International) in diets that contained 2 % fresh (FF) or oxidized (OF) soybean oil on milk production and composition and plasma antioxidant status of cows. Forty-four mid-late lactating primiparous cows were housed in a tie-stall barn and fed a diet that contained 2% FF for 15 days as adaptation period and them randomly allocated to the four dietary treatments (FF, FF+AO, OF, OF +AO) for six weeks. Feeding AO improved dry matter intake 3% ($P = 0.007$), milk yield 2.7% ($P = 0.08$), fat corrected milk 3.8% ($P = 0.01$), and milk fat yield 5.3% ($P = 0.01$). Feeding OF reduced dry matter intake 2.2% ($P = 0.04$) and BW at the end of the trial ($P = 0.05$) and increased milk fat yield 5.3% ($P = 0.02$). Feeding AO improved plasma total antioxidant status (TAS; $P = 0.002$) and the activity of antioxidant enzyme glutathione peroxidase ($P = 0.009$), whereas, feeding OF reduced TAS ($P = 0.003$) and increased accumulation of end products of oxidation in plasma ($P = 0.003$) at the end of the trial. It can be concluded that feeding OF reduced dry matter intake, BW, and the antioxidant status of the cow but improved milk fat yield. Feeding AO improved dry matter intake, milk yield and fat and the antioxidant capacity of the animal, independently of the degree of oxidation of the dietary fat.

Key Words: Antioxidants, Oxidized Fat, Agrado

913 The energetic and non–energetic effects of supplemental fish oil during the peripartum period on the metabolic status of multiparous Holstein cows. M. A. Ballou*, M. K. Yelle, R. C. Gomes, D. W. Kim, and E. J. DePeters, *University of California*, *Davis*.

The etiology of ketoacidosis and hepatic lipidosis during the peripartum period is complex. Increased energy demands and shifts in the hormonal and cytokine milieu play a role. In addition to its energy component, fish oil was shown to repress inflammation and alter gene expression profiles. The objectives were to evaluate the energetic and non–energetic effects of supplemental fish oil during the peripartum period on the metabolic status of multiparous cows. 42 Holstein cows were completely randomized to one of three treatments at 3 wk prepartum. Treatments were no supplemental lipid or supplemental lipid at either 250 g (prepartum) or 1% of the previous day's intake (postpartum), from either Energy Booster®(EB) or fish oil (FO). Supplemental lipid was fed as a bolus prior to the AM feeding. DMI was recorded daily; BW and BCS were measured at d -21, +1, +10, and +21. Peripheral blood samples were collected 3X weekly until 21 DIM. On d -21, -10, +1, and +14 a liver biopsy was performed to determine the FA, triglyceride, and glycogen concentration in the liver. Feed intake during the pre- and postpartum periods was not affected by either supplementing the diet with lipid or the source of lipid. Cows fed either lipid source lost similar BW and BCS during the peripartum period. Supplemental lipid had no effect on prepartum serum glucose concentrations, but postpartum glucose was higher for EB and FO compared with control (49.7, 50.7, 47.3 mg/dl; $P<0.05$) respectively. Serum NEFA concentration was lower in EB and FO both prepartum (0.28, 0.25, 0.50 mM; $P<0.02$) and postpartum (1.04, 0.88, 1.17 mM; $P<0.05$). Serum BHBA concentration was unchanged prepartum, but was lower in lipid supplemented cows postpartum (1.30, 1.25, 1.88 mM; $P<0.001$). There was no effect of either lipid or source on liver glycogen composition. Supplementing FO did not adversely affect intake; subsequently these cows had metabolic profiles that indicated better energy status. However, the effects of FO appear to be predominately due to the direct effects on energy intake rather than any non-energetic effects.

Key Words: Transition, Fish Oil, Metabolism

914 Lactation response and milk α-linolenic acid concentration in dairy goats fed different forage species supplemented with extruded linseed. A. Doyon*[1], G. F. Tremblay[2], D. Cinq–Mars[3], and P. Y. Chouinard[1], [1]*Nutraceuticals and Functional Foods Institute (INAF), Laval University*, *Quebec, QC, Canada*, [2]*Agriculture and Agri-Food Canada, Soils and Crops Research and Development Center*, *Quebec, QC, Canada*, [3]*Ministère de l'Agriculture, des Pêcheries et de l'Alimentation du Québec, Direction de l'innovation scientifique et technologique*, *Quebec, QC, Canada*.

Forages and linseed are two important sources of lipids in the diets of ruminant animals. The objective of this study was to evaluate the effect of forage species and extruded linseed supplementation on milk production and composition in dairy goats. Thirty six primiparous Alpine dairy goats (90 days in milk; 48 kg body weight) were randomly assigned to 6 dietary treatments within a 3×2 factorial arrangement in a 4 week experiment. Treatments were three forage species (corn, alfalfa, and annual ryegrass silages) fed at 60% of dry matter in a TMR supplemented with 0 or 17% extruded linseed (EL). Diets were

formulated to be isonitrogenous, and goats were allowed ad libitum consumption. Treatment differences were compared at week 4 with data from week 0 used as covariates. Alpha-linolenic acid (*cis*-9, *cis*-12, *cis*-15 C18:3) concentration in TMR was 2.0, 8.8, 16.0, 43.8, 56.8, and 60.6 mg/g DM for corn, alfalfa, ryegrass, corn+EL, alfalfa+EL, and ryegrass+EL, respectively. Dry matter intake, milk yield, protein yield, true protein yield, and casein yield were lower, and milk fat content was higher when goats were EL supplemented as compared to nonsupplemented rations ($P<0.01$). Goats fed alfalfa had a higher milk fat content compared to those fed corn or ryegrass ($P<0.01$), and a higher milk fat yield compared to goats fed corn silage ($P<0.01$). The milk fat concentration (mg/g of FA) of α-linolenic acid was increased by the EL supplement ($P<0.01$), and this increase was more pronounced ($P<0.05$) with corn (3.4^{d} vs. 17.2^{a}), intermediate with alfalfa (8.8^{c} vs. 16.4^{a}), and lower with ryegrass (11.1^{b} vs. 17.2^{a}) silage. In conclusion, the concentration of omega-3 fatty acids in milk of dairy goats can be increased by feeding forage species rich in α-linolenic acid and it can be further increased by supplementation with EL.

Key Words: Milk Fatty Acids, Omega-3 Fatty Acids, Forage Fatty Acids

915 Predicting production of de novo fatty acids in milk. P. J. Moate*[1], W. Chalupa[1], R. C. Boston[1], and I. J. Lean[2], [1]*University of Pennsylvania*, *Kennett Square, PA*, [2]*Sydney University*, *Sydney, NSW, Australia*.

We have developed a model to describe effects of diet and cow factors on milk fat concentration and concentrations of individual long chain fatty acids (LCFA) in milk. We collated data on milk from 120 treatment groups of cows described in 29 published dietary experiments. The diets included a wide variety of fat supplements and wide range in fatty acid intakes (258 - 1794 g/d). Mixed effects modeling was used to relate dietary and cow factors to total production of C4-C15 fatty acids (TPdenovo) [g/d]. The regression equation which best described TPdenovo was:

$$TPdenovo = 190 \pm 41 + 24.8 \pm 4.42^{*} IFCHO - 1.01 \pm 0.163^{*}ATuFA + 0.0018 \pm 0.0004^{*}ATuFA^{2} - 0.25 \pm 0.029^{*}IFishFA - 21.2 \pm 10.7^{*}Diet - 6.46 \pm 2.20^{*}DIM^{0.5}$$

Where IFCHO (kgDM/d) represents intake of fermentable carbohydrate, ATuFA (g/d) is the estimated (by CPM-Dairy) amount of unsaturated fatty acids absorbed from the diet, IFishFA (g/d) is the intake of fish-oil fatty acids, Diet is a categorical variable (0 = Pasture diet, 1 = TMR) and DIM is days in milk. The R^2 for this regression was 0.76 and the RMSE was 37.4 (g/d). Milk fatty acids containing 4 to 15 carbon atoms and approximately half of the C16 fatty acids are generally considered to be synthesized de novo in the udder. Univariate regressions revealed strong linear relationships between the total production of de novo fatty acids and production of individual de novo fatty acids. The slope coefficients for these regressions indicate that each of the individual fatty acids constitute a fairly fixed proportion of the total production of de novo fatty acids. The estimated coefficients (± SE) were: C4:0 0.12 ± 0.01; C6:0 0.082 ± 0.004 ; C8:0 0.052 ± 0.003 ; C10:0 0.111 ± 0.003; C12:0 0.134 ± 0.004; C14:0 0.441 ± 0.007; C14:1 0.046 ± 0.002; and for C15:0 0.043 ± 0.002. These findings present a simple method to predict daily production of individual de novo fatty acids.

Key Words: Model, Predict, de Novo Fatty Acids

916 Effect of in vitro DHA supplementation to adapted and non-adapted rumen inoculum on the biohydrogenation of linolenic and linoleic acid. B. Vlaeminck[1], G Mengistu[2], J. Dijkstra[2], and V. Fievez*[1], [1]*Laboratory for Animal Nutrition and Animal Product Quality*, *Ghent University, Belgium*, [2]*Animal Nutrition Group*, *Wageningen University, The Netherlands*.

The objective was to examine the ruminal biohydrogenation of linoleic (C18:2 n-6) and linolenic (C18:3 n-3) acid during in vitro incubations with rumen inoculum from dairy cattle adapted or not to DHA and either with or without additional DHA supplementation in vitro. Treatments were incubated in 100 ml flasks containing 400 mg freeze dried grass, 5 ml strained ruminal fluid and 20 ml phosphate buffer. Ruminal fluid was collected just before the morning feeding from three cows receiving a control diet (49% ryegrass silage, 39% corn silage, 1% straw and 11% concentrate, fresh weight basis) supplemented with marine algae for 21d (DHA-adapted population, Adapt) or from the same cows receiving the control diet only (non-adapted population, non-Adapt). In half of the incubation flasks, pure DHA (5mg) was added as an oil-ethanol solution (100 µl). Incubations were carried out during 0, 0.5, 1, 2, 4, 6 and 24h. After 24h, in vitro addition of DHA resulted in higher amounts (mg/incubation) of C18:3 n-3 (0.23, 0.43, 0.26 and 0.34 for Adapt, Adapt+DHA, non-Adapt and non-Adapt+DHA, respectively, SEM=0.047), C18:2 n-6 (0.14, 0.22, 0.15 and 0.20, SEM=0.071) and trans-11, cis-15 C18:2 (0.27, 2.40, 0.06 and 2.20, SEM=0.220) whereas no effect of inoculum source was observed. Trans-11 C18:1 accumulated after 24h when Adapt was incubated irrespective of DHA supplementation, whereas in incubations with non-Adapt, accumulation of trans-11 C18:1 only occurred when DHA was added (6.40, 4.35, 1.06 and 3.91, SEM=0.047). The increased amounts of trans-11 C18:1 was due to the strong inhibition of the reduction to C18:0. Indeed, after 24h, the amount of C18:0 was significantly different from 0h for the non-Adapt treatment without in vitro DHA only (0.49, 0.34, 8.95 and 2.14, SEM=0.369). The results show the DHA-adapted microbial population is able to convert trans-11, cis-15 C18:2 but not trans-11 C18:1 whereas DHA inhibits the conversion of both trans-11, cis-15 C18:2 and trans-11 C18:1.

Key Words: Biohydrogenation, DHA, Rumen

917 Identification of enriched conjugated linoleic acid isomers in cultures of ruminal microorganisms after dosing with 1-^{13}C-linoleic acid. Y-J. Lee*[1], J. T. Brenna[2], P. Lawrence[2], S. K. Duckett[1], G. L Powell[1], W. C. Bridges, Jr.[1], and T. C. Jenkins[1], [1]*Clemson University*, *Clemson, SC*, [2]*Cornell University*, *Ithaca, NY*.

Most accounts of linoleic acid biohydrogenation depict its conversion to only a single conjugated linoleic acid (CLA) isomer (c9t11). A multitude of other CLA isomers have been identified in ruminal contents, raising questions that the pathway of linoleic acid biohydrogenation is more complex. The objective of this experiment was to identify CLA isomers that arise from ruminal biohydrogenation of linoleic acid. Six rumen in vitro cultures were run that contained ground dairy feed (with 5% added unsaturated fatty acids), buffer, and strained rumen fluid from a ruminally-fistulated dairy cow. Half of the cultures received an additional 50 mg of unlabelled linoleic acid in 1 mL of ethanol and the other half received a mixture of 15 mg 1-^{13}C-linoleic acid and 35 mg unlabelled linoleic acid in ethanol injected at the start of incubation. Samples were taken from each flask at 0, 24, and 48 hours. Methyl esters of fatty acids were separated on a 100-m CP-Sil 88 column and abundances of the quasimolecular ion (M) and M+1 ion were

determined by mass spectroscopy in positive chemical ionization mode using methane reagent gas. Geometry and double bond position of CLA isomers was verified by acetonitrile chemical ionization tandem mass spectrometry. Enrichment for each peak was calculated as [(M+1/M) * 100] in labeled minus unlabelled cultures and tested for their difference from zero by t-test ($P < 0.05$). At 48 h of incubation, enrichment was observed in t11 18:1 (14.2%), 18:0 (2.7%), and seven CLA isomers (range from 18.1 to 30.7%). The c9t11 isomer had the highest enrichment (30.7%), followed by enrichments from 20.8 to 23.4% for t10c12, c10t12, t9t11, and t10t12. The remaining two CLA isomers (c9c11 and c10c12) had enrichments of 18.1 and 19.2%, respectively. The results of this study verified the formation of c9t11 and t10c12 CLA isomers from linoleic acid biohydrogenation. An additional five CLA isomers also contained carbons that originated from linoleic acid indicating that pathways of linoleic acid biohydrogenation are more complex than usually depicted.

Key Words: Linoleic Acid, Biohydrogenation, Conjugated Linoleic Acid

918 Octadeca-carbon fatty acids affect microbial fermentation, methanogenesis and microbial flora in vitro. C. M. Zhang*[1], J. X. Liu[1], Y. Q. Guo[1], Z. P. Yuan[1], J. K. Wang[1], and W. Y. Zhu[2], [1]*College of Animal Sciences, Ministry of Education Key Laboratory of Molecular Animal Nutrition, Zhejiang University*, *Hangzhou, Zhejiang, P.R. China*, [2]*College of Animal Science and Technology, Nanjing Agricultural University*, *Nanjing, Jiangsu, P.R. China*.

The effects of type and level of C18-fatty acids on rumen fermentation, methane emission and microbial community structure were examined using an in vitro gas production technique (Reading Pressure Technique). Three levels (0, 3.5 and 7.0% of substrate DM) were evaluated for four types of C18-fatty acids: stearic acid, oleic acid, linoleic acid and linolenic acid. The 24 h gas production and methane emission were significantly decreased by type, level and their interactions ($P<0.001$). Methane suppressing effect of unsaturated C18-fatty acids was more profound than on gas production. Compared to the control, addition of C18-fatty acids had little effect on pH, concentration of ammonia-N and total volatile fatty acids. However, the fermentation patterns were significantly changed ($P<0.001$), with lower proportion of acetate and higher propionate with increasing levels and unsaturation of C18-fatty acids. Methanogens and protozoa population relative to total bacteria were decreased by linoleic and linolenic acids, with the linolenic acid being more effective. However, addition of these unsaturated C18-fatty acids also inhibited growth of fibrolytic microbes including fungi, *F. succnogens* and *R. flavefaciens*. From the present study, it is demonstrated that there is a significant effect of unsaturated C18-fatty acids on suppressing methanogenesis, mediated probably by a direct action against the rumen microbes involved in methane formation and by a decreased hydrogen supply.

Key Words: C18-Fatty Acids, Methane Emission, Microbial flora

919 Effect of feeding rate of a 26% CP calf milk replacer. T. M. Hill*, H. G. Bateman, II, J. M. Aldrich, and R. L. Schotterbeck, *Akey*, *Lewisburg, OH*.

The objective was to determine the effect of feeding rate of a 26% CP, 17% fat milk replacer (MR) on calf ADG, starter intake, and efficiency. Single source Holstein calves (d 0 = 42 ± 2 kg, 3-4 d old) were fed different amounts of the MR and weaned on d 42. They were offered free-choice water and 18% CP starter in individual pens within a naturally ventilated barn with no supplemental heat. In Trial 1, MR (16 calves/MR) were fed at A) 681 g/d, B) increased to 795 g/d by day 8, or C) increased to 908 g/d by d 15. In Trial 2, MR (24 calves/MR) were fed at A) 681 g/d or C) increased to 908 g/d by d 14. In Trials 1 and 2, calves were weaned by feeding half of the MR amount on d 39-42. In Trial 3, the MR (24 calves/MR) were fed at A) 681 g/d or D) increased to 1,135 g/d by day 22. Calves were weaned by feeding half of MR A on d 39-42 or half of MR D on d 36-42, in Trial 3. In Trials 1-3, post-weaning measurements were made in the individual pens until d 56 and no calf rejected any MR fed. Each trial was analyzed as a randomized block design. In each trial, calves fed MR A grew the slowest ($P < 0.05$) during d 1-21. In Trial 1, starter intake and efficiency from 0-42 d declined linearly as MR increased ($P < 0.05$), while ADG did not differ from 0-42, 42-56, and 0-56 d. In Trial 2, calves fed MR A had the slowest ADG, were least efficient, and consumed the most starter from 0-42 d and had the fastest ADG, were most efficient, and consumed the most starter from 42-56 d ($P < 0.05$). The ADG from 0-56 d did not differ between MR. In Trial 3, calves fed MR A had the slowest ADG, were least efficient, and consumed the most starter from 0-42 d and had the fastest ADG, were most efficient, and consumed the most starter from 42-56 ($P < 0.05$). The ADG from 0-56 d did not differ between MR. In summary, calf ADG from 0-56 d was not improved when the 26% CP MR was fed at more than 681 g/d because starter intake and efficiency was decreased at higher feeding rates.

Key Words: Calves, Milk Replacer

920 Effect of CP concentration in a post-weaning calf grower. T. M. Hill*, H. G. Bateman, II, J. M. Aldrich, and R. L. Schotterbeck, *Akey*, *Lewisburg, OH*.

The objective was to determine to the effect of CP concentration in the diet for weaned calves. The four treatments were A) 13.5, B) 15.0, C) 16.5, and D) 18.0% CP (as-fed basis). Each feed contained 3% molasses, 12.5% pellet (34% CP, minerals, vitamins), and 25% whole oats. Rolled corn and a 40% CP pellet (77.7% soybean meal, 12.8% wheat midds, 5% alfalfa meal, 3% binder, 1.5% fat) were varied to achieve the targeted CP concentration. The feeds (blended with 5% chopped grass hay, 14% CP as-fed) and water were fed free-choice. Single source Holstein steers (d 0 = 81 ± 2 kg, 59-60 d old) that had been weaned 28 d from a 26% CP, 17% fat MR fed at 0.68 kg/d were used. Calves were fed for 28 d in pens (4 pens/treatment, 6 calves/pen). Calves were weighed, hip widths and body condition were measured on d 0 and 28. Feed offered and refused was measured daily. Venous blood of calves from 2 pens/treatment) were also sampled on d 0 (baseline values), 7 and 28 and analyzed for several constituents. The change in blood constituent from d 0 was calculated. Performance measures (as a randomized block design) and blood measures (as a completely randomized design) were analyzed with pen being the experimental unit using polynomial contrast statements to characterize the treatments. Body weight gain (A= 0.99, B= 1.09, C= 1.11, D= 1.11, SEM= 0.02 kg/d), efficiency (A= 0.33, B= 0.36, C= 0.36, D= 0.35, SEM= 0.009 gain/feed), and change in hip width (A= 2.0, B= 2.2, C= 2.2, D= 2.2, SEM= 0.07 cm) increased quadratically ($P < 0.05$) to concentration of CP in the diet with calves fed A being lowest. The change in serum urea nitrogen (A= -2.7, B= -1.3, C= -0.8, D=

-0.6, SEM= 0.2 mmol/L) and creatinine (A= +11.3, B= -7.3, C= -5.8, D= -7.2, SEM= 3.5 umol/L) concentration from d 0-28 increased in a quadratic ($P < 0.05$) manner as CP concentration of the diet increased. These results indicated that 13.5% CP diets were deficient, 15% CP diets were marginal, and 16.5 and 18% CP diets were adequate for calves 2-3 months of age.

Key Words: Calves, Protein

Sheep Species: Sheep Production and Management

921 Cobalt supplementation to the pregnant ewe reduces vitamin E levels in the newborn lamb. T. M. Boland*, L. Hayes, J. J. Murphy, T. Sweeney, J. J. Callan, and T. F. Crosby, *University College Dublin*, *Belfield, Dublin 4, Ireland*.

The objective of this experiment was to determine the effects of offering supplementary iodine or cobalt during late pregnancy on lamb serum vitamin E and IgG concentrations at 24 and 72 h *post partum*. Sixty twin-bearing ewes were individually penned and offered grass silage *ad libitum* supplemented with 800g/ewe daily of a 190g/kg crude protein concentrate, with or without supplemental cobalt or iodine, from day 126 of gestation until parturition. Ewes were allocated to one of the following treatments: **C:** no mineral supplement; **I-3:** 26.6 mg iodine from day 126 – parturition; **I-1:** 26.6 mg iodine from day 138 – parturition; **Co-3:** 20 mg cobalt from day 126 – parturition. Colostrum yield was measured following hand milking at 1, 10 and 18 h *post partum*, after which the lambs were fed measured quantities of colostrum, via stomach tube. A 10 ml blood sample was taken from lambs at 24 and 72 h *post partum* for IgG and vitamin E determination. The efficiency of IgG absorption at 24 h *post partum* was lower in the progeny of ewes offered supplementary iodine for either one or three weeks (I-3; 0.08, I-1; 0.18) than in the progeny of the ewes not offered supplementary iodine (C; 0.26, Co-3; 0.28; $P < 0.001$) resulting in reduced IgG concentrations at both 24 and 72 h *post partum* ($P < 0.001$) in the lamb's serum. Lamb serum vitamin E concentration was lower for both of the iodine supplemented treatments than for Co-3 at 24 h *post partum* (2.02, 2.06 v. 2.48; sem 0.137), while at 72 h *post partum* the lamb serum for all mineral supplemented treatments (I-3, I-1 and Co-3) had lower vitamin E levels than in the control (C) lambs ($P < 0.01$). We conclude that not only do excessively high levels of dietary iodine in late pregnancy lead to a reduction in IgG and vitamin E transfer but that excessively high dietary cobalt in late pregnancy (20 mg per ewe per day) also leads to a breakdown in the transfer of vitamin E from colostrum to the serum of the newborn lamb.

Key Words: Cobalt, Iodine, Vitamin E

922 Evaluation of alternative small ruminant finishing systems for the tropics. S. A. Weiss*, R. C. Ketring, and R. W. Godfrey, *University of the Virgin Islands, St. Croix*, *Kingshill*.

The objective of the experiment was to evaluate the growth and carcass characteristics of Dorper $/times; St. Croix White lambs managed in two types of post-weaning alternative pasture finishing systems in the tropics. After weaning and background grazing on native pasture for eight months, lambs (n = 37) were stratified by weight and sex into two treatments consisting of native pasture (NP) and improved pasture (IP), with energy supplement. Native pasture consisted of a mix of guinea grass (Panicum maximum) and hurricane grass (Boithrocloa pertusa), while IP consisted of a mix of seeded tropical legumes (Desmanthus vergatus, clitoria ternetea, and Lablab purpureus) and volunteer guinea grass. All lambs were supplemented with crushed corn daily at 1% of BW for 100 d and slaughtered at approximately 365 d of age. During the finishing trial, IP lambs had greater total weight gain ($P < 0.0001$) than NP lambs (10.8 vs. 6.8 ± 0.6 kg, respectively). In addition, IP lambs had higher ADG ($P < 0.0001$) than NP lambs (112.2 vs. 66.5 ± 5.9 g/d, respectively). Compared to NP lambs, IP lambs were heavier at slaughter ($P < 0.0001$; 37.8 vs. 32.4 ± 0.9 kg, respectively), had heavier carcasses ($P <0.0001$; 18.7 vs. 15.1 ± 0.6 kg, respectively), and greater dressing percentages ($P = 0.0633$; 49.5 vs. 46.7 ± 1.1%, respectively). Further, IP lambs had greater leg circumference ($P < 0.0005$; 43.4 vs. 40.1 ± 0.6 cm, respectively), body wall thickness ($P < 0.0001$; 14.8 vs. 9.6 ± 0.7, mm, respectively), and rib eye area ($P <0.0001$; 12.9 vs. 10.1 ± 0.4 cm^2, respectively) than NP lambs. Back fat thickness for IP and NP lambs was 3.1 and 2.1 ± 0.3 mm, respectively ($P < 0.02$). The IP lambs had greater percent KPH ($P < 0.02$) than NP lambs (3.8 vs. 3.1 ± 0.2%, respectively). In this study, crossbred hair sheep lambs grown under tropical conditions responded with improved growth rate and carcass muscularity to mixed legume improved pasture but had similar yield grades compared to lambs grown on native pasture.

Key Words: Sheep, Legumes, Pasture Finishing

923 Potential for onions to reduce bitterweed toxicity in sheep. E. S. Campbell*[1], T. R. Whitney[2], C. A. Taylor[1], and N. Garza[1], [1]*Texas Agricultural Experiment Station*, *Sonora, TX*, [2]*Texas Agricultural Experiment Station*, *San Angelo, TX*.

Bitterweed (*Hymenoxys odorata*) toxicity is a major cause of death losses in sheep. Supplements high in sulfhydryl groups (i.e. L-cysteine) can be used to prevent bitterweed intoxication. Cull onions (*Allium cepa*) are an inexpensive and commercially available feed source that also contain high levels of naturally occurring disulfide compounds. Yearling Rambouillet (n = 12; 22.9 kg BW) and Dorper $/times; Barbado (Dorpado) ram lambs (n = 12; 22.5 kg BW) were used to evaluate whether onions have the potential to reduce bitterweed toxicity in sheep. Each breed was randomly assigned to one of four groups: no onions, 25% onions, 50% onions, and 75% onions (DM basis). The remainder of the isonitrogenous diet consisted of alfalfa pellets to provide 43 g DM/kg BW per d. The study was divided into three periods. Period 1 represented control data, prior to onion and bitterweed challenge. In period 2, lambs were incrementally adapted to respective onion diets for 14 d. In period 3 lambs were dosed with an aqueous slurry of dried bitterweed (0.25% live weight) for five days. At the end of each period blood samples were analyzed for serum chemistry measurements. Hematocrits, overall DMI and feed refusals were also measured. The statistical model included breed, onion level, and the two-way interaction. Following period 3 there was a breed effect ($P < 0.05$) for serum measurements reflective of bitterweed

toxicity; GGT and AST levels were higher ($P < 0.001$) for Dorpados (465.6 U/l and 877.0 U/L) than for Rambouillets (117.1 U/L and 186.5 U/L), indicating greater susceptibility to hepatic insult by bitterweed. Bilirubin, though numerically greater for Dorpados (0.542 mg/dL) than Rambouillets (0.400 mg/dL) did not vary by breed ($P > 0.10$). For period 3 there was an inverse correlation (-0.42, $P < 0.05$) between level of onions in the diet and levels of serum GGT after bitterweed dosing. Results indicate that further study is required to confirm the benefit of onions as a prophylactic feed during periods of bitterweed consumption.

Key Words: Bitterweed, Sheep, Onions

924 Effectiveness of allopathic and homeopathic dewormers on gastrointestinal nematodes and gain in ewes. A. Baños L, E. Cortés D*, S. Vázquez, J. L. Zaragoza, P. A. Martínez, and T. González, *UACh-Chapingo*, *Mexico*.

The objective was to evaluate the effectiveness of 4 allopathic (Albendazole, Levamisole, Closantel, Avermectin) and 5 homeopathic (*Aconitum napellus L, Antimonium crudum, Azadirachta indica, Artemisia cina, Chenopodium ambrosoides*) dewormers on gastrointestinal nematode control and gain of hair sheep from two communities in Tepalcingo, Morelos, Mexico. Ten treatments were compared: the 9 dewormers and a control group. Treatments were assigned at random to ewes, 12 ewes per treatment. Fecal samples were taken directly from the rectum before deworming and every month from February 2005 to March 2006. Nematode egg count in feces was by McMaster and nematode identification by Coproculture. Ewes were weighed at the beginning of the study and every month thereafter. Allopathic dewormers were administered every 3 mo and homeopathic dewormers were administered at 2 wk intervals. Data were analyzed as a completely randomized split-plot design. The main plot was the dewormer and the sub plot was the sampling date. Nematode egg count was different ($P < 0.01$) among sampling dates and treatments. There were two peaks (April to May and November to January); both considered as a reflection of the nematode life-cycle in a tropical range and both occurred at the same time as lambing. Allopathic and homeopathic dewormers showed similar ($P > 0.05$) nematode-egg counts which were lower than in control ewes (872 eggs/g feces). Monthly live-weight change was not different ($P > 0.05$) among treatments. The average monthly live-weight change per ewe ranged from 2348 to -474 g. Nematodes found were *Trychostrongylus, Bunostomum* and *Haemonchus*. This study shows that gastrointestinal nematode load in hair sheep can be controlled either by allopathic or homeopathic dewormers.

Key Words: Internal Parasites, Sheep, Dewormer

925 Influence of feeding tanniniferous sainfoin on the nitrogen balance of lambs artificially infected with the abomasal nematode *Haemonchus contortus*. A. Scharenberg[1], Y. Arrigo[1], F. Heckendorn[2], H. Hertzberg[2], A. Gutzwiller[1], H. D. Hess[1], M. Kreuzer[3], and F. Dohme*[1], [1]*Agroscope Liebefeld-Posieux, Research Station ALP*, *Posieux, Switzerland*, [2]*Research Institute for Organic Farming (FiBL)*, *Frick, Switzerland*, [3]*ETH Zurich, Institute of Animal Science*, *Zurich, Switzerland*.

Condensed tannins (CT) have the potential to suppress gastrointestinal nematodes in sheep. However, it is unclear, if the anthelmintic effect results from a direct impact of CT on the nematodes or from counterbalancing the nematode-caused higher protein requirements of the host by ruminal protection of dietary protein. To evaluate the effects of CT on infected lambs, 24 lambs, 18 of which were infected with the blood sucking abomasal nematode *H. contortus*, were subjected to 4 treatments (n = 6). After 4 wk, when the infection was established, 12 infected lambs were fed for 3 wk either dried sainfoin or dried sainfoin treated with polyethylene glycol (PEG) which inactivates CT. The third infected group and the uninfected group remained on a grass-clover hay diet. The lambs were offered 66 g/d forage OM per kg $BW^{0.75}$. To monitor the infection, egg count in fecal DM (FEC) and packed cell volume in the blood (PCV) were determined weekly throughout the experiment. During the third experimental wk, feed refusals were recorded daily, and feces and urine were collected quantitatively and results expressed per d and per kg $BW^{0.75}$. While the DM intake was not affected by treatments, the nitrogen (N) intake was higher in lambs fed PEG-treated sainfoin instead of grass-clover (2.29 vs. 1.51 g; $P < 0.001$) which resulted in a higher total N-excretion (1.64 vs. 1.22 g; $P < 0.001$) and a higher N-retention (0.65 vs. 0.29 g; $P < 0.001$). Lambs fed PEG-treated sainfoin excreted less fecal N than lambs fed sainfoin without PEG (0.66 vs. 0.75 g; $P < 0.01$). The proportion of urinary N (g/g N excreted) was higher with PEG-treated sainfoin than with untreated sainfoin ($P < 0.05$). The nematode infection had no influence on the N-balance. The PCV was lower in infected compared to uninfected lambs ($P < 0.001$). The FEC was not different among the 3 infected groups and averaged $10.5 \pm 8.21 \times 10^3$ eggs/g fecal DM at the end of the experiment. In conclusion, neither the CT of sainfoin nor the higher N-intake with sainfoin compared to grass clover increased the resilience of lambs infected with *H. contortus*.

Key Words: Nitrogen Balance, Condensed Tannins, Haemonchus Contortus

926 Prediction of carcass measures and wholesale product weights in sheep using B-mode ultrasound. T. D. Leeds*[1], M. R. Mousel[1], D. R. Notter[2], and G. S. Lewis[1], [1]*USDA-ARS, U. S. Sheep Experiment Station*, *Dubois, ID*, [2]*Virginia Polytechnic Institute and State University*, *Blacksburg*.

Widespread use of ultrasound (US) in the sheep industry to predict carcass traits requires knowledge of its reliability. Our objectives were to 1) evaluate US estimates of carcass measures in live sheep via correlations (r) and other statistical measures (prediction SE [SEP]; repeatability SE [SER]; and bias [TB]) established for beef and swine; and 2) compare US estimates of loin muscle area (LMA), depth (LMD), width (LMW), and an elliptical interpretation (LME) as single predictors of roast ready rack (RRR) and trimmed loin (TL) weights. Wethers (n = 172) from four sire breeds were reared in an extensive production system, weaned at approximately 130 d, finished on a concentrated diet, and harvested at a mean weight of 62.9 kg (SD = 9.5 kg). Before harvest, $12^{th}/13^{th}$ rib transverse US images were captured using an ALOKA SSD-500V US device with a 3.5-MHz, 14.5-cm linear transducer and standoff. Images were interpreted using ImageJ software (v1.36b). After a 24-h chill, carcasses were ribbed, measured for LMA and backfat (BF), and fabricated. Weights of RRR and TL were described using linear models with LMA, LMD, LMW, and LME as single predictors. Predictors were evaluated via model R^2 and root

mean square error (RMSE) statistics. For Objective 1, SEP, SER, and TB for BF were 0.14, 0.08, and 0.07 cm, respectively, and r was 0.81. The SEP, SER, and TB for LMA were 1.55, 1.31, and -0.004 cm^2, respectively, and r was 0.75. For Objective 2, single-prediction models for RRR had R^2 of 0.46, 0.09, 0.40, and 0.37 and RMSE of 0.22, 0.28, 0.23, and 0.24 for LMA, LMW, LMD, and LME, respectively. Single-prediction models for TL had R^2 of 0.46, 0.11, 0.39, and 0.38 and RMSE of 0.31, 0.39, 0.33, and 0.33 for LMA, LMW, LMD, and LME, respectively. Based on these data, the best single predictor for RRR and TL was LMA; LMW and LME should not be used to predict RRR or TL. Ultrasound can be used to reliably predict corresponding carcass measures in sheep.

Key Words: Sheep, Ultrasound, Carcass

927 Prediction of lamb carcass leg and loin weights using leg score and leg width measurements. M. R. Mousel*[1], T. D. Leeds[1], D. R. Notter[2], and H. N. Zerby[3], [1]*USDA-ARS U.S. Sheep Experiment Station*, *Dubois, ID*, [2]*Virginia Polytechnic Institute and State University*, *Blacksburg*, [3]*The Ohio State University*, *Columbus*.

Lamb carcass leg score (LS; 1 = low cull to 15 = high prime) is considered a subjective estimate of carcass muscling. We compared the predictive value of LS, live leg width (LLW), and carcass leg width (CLW), individually, and in combination with live (LWT) or carcass weight (CWT), of various leg and trimmed loin (TL) weights. Wether lambs (n = 170) from four sire breeds were weaned at approximately 130 d, finished in a feedlot, and harvested at a mean weight of 62.9 (SD = 9.5) kg. Before harvest, LLW was measured at the widest point between hip and stifle. The CLW was measured on hanging carcasses at the dorsal tip of the visible gluteus and a trained evaluator assessed LS. As single-predictors of leg weights or TL, R^2 values ranged from 0.16 to 0.32 for LS, 0.31 to 0.48 for LLW, 0.60 to 0.83 for CLW, 0.70 to 0.88 for LWT, and 0.75 to 0.95 for CWT (Table 1). Based on the data, CWT was the best single-predictor of leg and TL weights. When comparing LS, LLW, and CLW as single-predictors, CLW was consistently best. No additional leg weight ($P > 0.5$) and very little TL weight ($P < 0.08$) variation was explained when LLW was added to LWT model. The R^2 improved slightly for boneless leg weight when LS or CLW ($P < 0.01$) was added to CWT model. However, after accounting for CWT, LS and CLW explained a significant ($P < 0.01$) portion of leg weight variation.

Table 1. Model R^2 and root mean square error (RMSE) for predicting weights from live and carcass measurements.

Cut		LLW	LS	CLW	LWT	CWT	LLW + LWT	LS + CWT	CLW + CWT
Whole Leg	R^2	0.48	0.27	0.83	0.88	0.95	0.88	0.95*	0.96*
	RMSE, kg	1.16	1.37	0.66	0.57	0.35	0.57	0.35	0.34
Bone-in Leg	R^2	0.42	0.29	0.78	0.82	0.90	0.82	0.90*	0.90*
	RMSE, kg	0.76	0.84	0.46	0.42	0.32	0.42	0.31	0.31
Boneless Leg	R^2	0.39	0.32	0.78	0.70	0.79	0.70	0.81*	0.83*
	RMSE, kg	0.50	0.53	0.30	0.35	0.29	0.35	0.28	0.27
TL	R^2	0.31	0.16	0.60	0.70	0.75	0.71+	0.75	0.75
	RMSE, kg	0.35	038	0.27	0.23	0.21	0.23	0.21	0.21

*LS or CLW $P < 0.01$ in model; +LLW $P < 0.08$ in model.

Key Words: Sheep, Leg Measurement, Carcass

928 Influence of body weight and body condition score at breeding on conception and prolificacy of Merino and Composite Coopworth, East Friesian, Romney and Texel sheep in Tasmania, Australia. A. E. O. Malau-Aduli*[1], G. H. Bond[1], and M. Dunbabin[2], [1]*University of Tasmania*, *Hobart, Tasmania, Australia*, [2]*Bangor, Dunalley*, *Tasmania, Australia*.

We evaluated ewe conception and prolificacy in six flocks on three sheep farms with similar commercial management conditions in the Australian State of Tasmania. The aim was to investigate the effects of BW and BCS at mating, age group, and breed on reproductive traits. 1759 Merino, Composite Merino/Coopworth (M/Coop), Composite East Friesian/Romney (EF/Rom), and Composite Coopworth/East Friesian/Texel (Coop/EF/Tex) ewes of maiden (7 mo) and mature (18 to 30 mo) age groups were evaluated. Body weight and BCS of ewes were recorded before rams were introduced to the breeding mob. Ultrasound scanning 90 d after ram removal was carried out. Results demonstrated that ewes that conceived were consistently of greater BW and BCS than barren ewes. The average BW of non-pregnant, single, and multiple-bearing ewes were 41.3, 43.7, and 54.6 kg respectively, while their corresponding BCS were 2.77, 2.80, and 2.85. However, highly significant ($P < 0.0001$) breed, age group, and flock variations were observed: 7 mo-old maiden ewes had a significantly lower conception rate than 18 mo-old ewes at the same BW at breeding. Within the 18-mo age groups, percentages of non-pregnant ewes were 16.7, 3.0, and 2.4% and percentages of multiple fetus-bearing ewes were 1.4, 53.6, and 74.2% for Merino, Coop/EF/Tex, and M/Coop, respectively. The Coop/EF/Tex flocks were consistently more prolific than other breeds with 74.2, and 77.5% of ewes scanned as multiple fetus-carrying at ages 18 and 30 mo, respectively. Above BW of approximately 55 kg, the probability of multiple conceptions began to increase at a greater rate at the expense of single conceptions. The study shows that nutritional management prior to joining in commercial Tasmanian sheep flocks has the potential to increase reproductive performance in ewes. This is of particular importance when ewes are bred as lambs or from breeds with characteristically low fertility levels.

Key Words: Conception, Prolificacy, Sheep Bodyweight

929 Body weight changes and subsequent lambing rates of western white-faced ewes grazing winter range. J. B. Taylor*, C. A. Moffet, and T. D. Leeds, *USDA, ARS, U. S. Sheep Experiment Station*, *Dubois, ID*.

To describe BW change (BWC) and subsequent lambing rates of western white-faced ewes grazing on sagebrush steppe of the northwest United States, Columbia (1,174 records), Polypay (910 records), Rambouillet (1,280 records), and Targhee (868 records) ewe BW and lambing-rate records for 1989, 1990, and 1991 were extracted from the USDA, ARS, U. S. Sheep Experiment Station breed database. In December, after breeding each year (October to December), ewes were moved to winter range. Depending upon severity of climatic conditions and vegetation accessibility, ewes grazed winter range for 30 to 60 d. The BW that were analyzed were collected 2 d before winter-grazing commenced and 2 to 7 d after ewes were transported off winter range. Only data from litters with at least one live lamb were included in these analyses. Because initial BW may influence BWC during grazing, daily BWC was calculated as a proportion of initial BW: BWC, g•kg BW^{-1}/d = ([exit BW – initial BW] / initial BW) / d of grazing. Data were analyzed within each breed, with age as the fixed effect and

management year as the random effect. For all breeds, 2-yr-old ewes were lightest going on to winter range and had the lowest lambing rate. Ewes lost weight while grazing winter range, but mature BW, once achieved, was restored annually, with the exception of the 7-yr-old Targhee ewes. Regardless of breed or age, ewes were able to achieve acceptable lambing rates following early-gestational weight loss. Compared to younger ewes, lambing rates were similar or greater in older ewes, even though they generally lost more BW during winter grazing.

Key Words: Sheep, Winter Grazing, Reproduction

930 Changes in metabolic and endocrine measurements during feed restriction in dairy ewes with different BCS. G. Pulina*[1], G. C. Bomboi[2], A. Mazzette[1], B. Floris[2], C. Dimauro[1], S. P. G. Rassu[1], and A. Nudda[1], [1]*Dipartimento di Scienze Zootecniche - Università di Sassari*, *Sassari, Italy*, [2]*Dipartimento di Biologia Animale - Università di Sassari*, *Sassari, Italy*.

The effects of feed restriction on metabolic and endocrine measurements of Sarda lactating ewes were evaluated. Ten ewes, divided into two groups according to the level of BCS (low: BCS < 2.75; high: BCS > 2.75), were fed 2.5 kg of a complete pelleted diet (CPD) for 7 d (preliminary period, PRE), followed by 3 d (treatment period, RESTR) of feed restriction (1.25 kg/head per day of CPD, i.e. 50% of the intake of the PRE period) and 3 days of recovery (REC). Blood samples were collected at -24, -12, 0 (beginning of RESTR), 6, 14, 24, 36, 52, 76, and 126 h during the trial. Blood concentrations of NEFA, urea, glucose, insulin, leptin, and IGF-I were measured. Data were analyzed by a mixed model with BCS, period and their interaction as fixed factors and ewe within BCS as a random factor (Table 1). BCS did not show significant effects on any blood measurement. Period influenced almost all measurements, except glucose concentration. Blood IGF-I and insulin concentrations showed a rapid response to feed restriction whereas the effect of feed restriction on NEFA, urea and leptin concentrations was observed in the REC period. The expected increase in NEFA during the RESTR period was observed only in low BCS ewes, whereas this measurement tended to slightly decrease in the high BCS group. Low BCS ewes had lower insulin concentrations during the PRE and RESTR periods than high BCS, whereas the opposite happened during the REC period. The results suggest that feed restriction of 50% for only a 3-d period is enough to cause metabolic changes in lactating dairy ewes. Moreover the differences found between the two BCS groups suggest an important role of the capability of body reserve mobilization when feed restriction occurs. *Funded by MIPAF project on Small Ruminant Welfare.*

Table 1. Metabolic and endocrine measurements

Parameter	Period PRE	Period RESTR	Period REC	BCS High	BCS Low	*P* level Per	*P* level BCS	*P* level P x BCS
Urea, mg/dL	55.6^{A}	52.5^{A}	36.0^{B}	47.9	48.2	**	ns	†
Glucose, mg/dL	69.8	72.2	72.1	71.0	71.8	ns	ns	ns
Leptin, ng/mL	3.75^{a}	3.70^{a}	3.36^{b}	4.15	3.05	*	ns	ns
Insulin, µ/dL	0.16^{a}	0.22^{b}	0.53^{c}	0.31	0.30	**	ns	**
IGF-I, ng/mL	111^{a}	102^{b}	118^{a}	119	102	**	ns	ns
NEFA, mmol/L	0.137^{ef}	0.156^{e}	0.125^{f}	0.121	0.157	†	ns	*

$^{A,B}P < 0.01$; $^{a,b,c}P < 0.05$; $^{e,f}P < 0.10$; †$P < 0.10$; *$P < 0.05$; **$P < 0.01$; ns = not significant

Key Words: Feed Restriction, Dairy Sheep, Metabolic Parameters

Thursday, July 12, 2007
SYMPOSIA AND ORAL SESSIONS

Beef Species II: Feed Intake and Efficiency

931 Energy cost of cows' grazing activity: Estimation in large plots. A. Brosh*, Z. Henkin, E. D. Ungar, A. Dolev, A. Orlov, Y. Shabtay, Y. Yehuda, and Y. Aharoni, *Beef Cattle Section, Newe Yaar Research Center*, *ARO, Israel*.

This study of 17 grazing beef cows on the herbage range was designed to compare previously published data of total daily energy expenditure (EE) and the energy cost of various activities measured in medium-size plots of 28 ha to those determined in larger plots of 145.8 and of 78 ha. Data were obtained by continuously monitoring EE using the heart-rate method and simultaneously monitoring the cows' location and activity with Global Positioning System (GPS) collars with motion sensors. The cows were monitored through March (lactating cows on high quality herbage), May (non-lactating cows on low quality herbage), and September (non-lactating cows on low quality herbage supplemented with poultry manure). These data were compared to previously published data that were determined on smaller plots. Three statistical models were evaluated, including one which was designated as a stepwise model. Across seasons the cows total daily EE (kJ•kgBW$^{-0.75}$•d^{-1}) ranged from 644 in September up to 1014 in March, and all activities together (grazing, standing and walking) ranged respectively from 58 to 66. The cows` daily vertical and horizontal locomotion ranged from 85 to 124 m and from 2.51 to 3.44 km, respectively. The time spent standing and grazing ranged from 6.6 to 9.0 h and from 7.4 to 11.7 h respectively; horizontal distance traveled while grazing ranged from 1551 to 2327 m/d. These data ranges and effect of month were similar to those measured in comparable months in medium plots. Plot size did not directly affect the duration of time the cows spent on each activity and consequently the energy cost of these activities. However, when the herbage was dry, cows in larger plots grazed longer and expended more energy on grazing activity, and probably consumed more herbage of significantly better quality than in medium plots, as was expressed by the greater daily energy expenditure.

Key Words: Grazing Cows, Energy Cost, Global Positioning System

932 Relationships among exit velocity, cortisol, and carcass characteristics of beef heifers. R. R. Reuter[1,2], J. D. Dailey*[2], J. A. Carroll[2], M. S. Brown[3], and M. L. Galyean[1], [1]*Texas Tech University*, *Lubbock*, [2]*USDA-ARS Livestock Issues Research Unit*, *Lubbock, TX*, [3]*West Texas A&M University*, *Canyon*.

One hundred ninety-nine crossbred beef heifer calves (205 ± 7.9 kg initial BW) were used in a 44-d receiving trial with 2 dietary treatments (9 pens/treatment) in a completely randomized design. Heifers were weighed and bled on d 0, 16, 30, and 44 after arrival. Blood was collected by jugular venipuncture, and serum was analyzed for cortisol, several cytokines, and 2 acute-phase proteins. Exit velocity was recorded by an electronic infrared timer system each time heifers were weighed. Animals were brought to the processing facility in pen groups of 10 to 12, and no effort was made to control processing sequence of individual animals. Exit velocity was not related ($P = 0.71$) to processing sequence. Repeatability of exit velocity was 77%. A trend was evident for a negative linear relationship between average exit velocity and 44-d ADG ($P = 0.08$) and for positive linear relationships between exit velocity and serum cortisol ($P = 0.10$) and interferon-gamma concentrations ($P = 0.13$). At d 44, the heifers were transported to a commercial feedlot, fed for 200 d, and individual carcass data were collected at slaughter. After controlling for treatment and pen effects, exit velocity, averaged over the 4 measurement times, was not related to carcass characteristics ($P > 0.23$) nor to ADG over the entire 240-d trial ($P = 0.92$). Although exit velocity measured during the receiving period seemed to be associated with increased serum cortisol and decreased ADG during the receiving period, it was not associated with ADG or carcass measurements after an extended feeding period. Thus, further research is needed to determine whether extended feeding periods during which cattle are not handled might mitigate deleterious effects of exit velocity on cattle performance.

Key Words: Beef Cattle, Carcass, Cortisol

933 Evaluation of a mathematical model to estimate total feed required for pen-fed animals based on performance and diet information. B. M. Bourg*[1], L. O. Tedeschi[1], and M. S. Brown[2], [1]*Texas A&M University*, *College Station*, [2]*West Texas A&M University*, *Canyon*.

The Cattle Value Discovery System (CVDS) was developed to predict growth and body composition based on animal, diet, and environment information, and to allocate feed to individual cattle fed in pens. The objective of this study was to evaluate the adequacy of CVDS in predicting total DM required (DMR) of pen-fed steers, based on either mean BW method (MBWM) or using the dynamic iterative growth

model (DIM). Steers (N= 1,314) used in this evaluation were fed in 173 pens for an average of 133 days on test, across 8 studies conducted at West Texas A&M University. Diet ME values ranged from 2.78 to 3.13 Mcal/kg DM. The CVDS model was used to predict individual DMR and to estimate total DMR of each pen. Model adequacy was analyzed using the Model Evaluation System (MES). The mean of observed DM allocated to pens was 10,258 kg and the mean pen DMR predicted by the CVDS was 10,630 and 10,267 kg for MBWM and DIM methods, respectively. The regression of observed on predicted values indicated a high precision of both methods (r^2 of 0.97) and no outliers were identified. The intercept and slopes of the regressions differed from zero and one simultaneously. Both methods had great accuracy based on the Cb value of 0.98 and 0.99 for MBWM and DIM methods, respectively. The mean biases were -3.5% ($P < 0.01$) and -0.08% (P=0.83) for MBWM and DIM methods, respectively. The balance analysis revealed that both methods tended to overpredict DMR for pens with greater than average DMI. The mean square error of prediction (MSEP) for the MBWM indicated that 26% of the error was attributed to mean bias, 30% to systematic bias, and only 44% to random error. For the DIM method, these values were 0.025%, 23%, and 77%, respectively. These results suggested that the CVDS model using either MBWM or DIM was highly precise and accurate in predicting DMR for pen-fed steers, but further work is needed to decrease mean and systematic biases when using the MBWM method and account for more of the random variation for the DIM method.

Key Words: Modeling, Feed Intake, Simulation

934 Genetic trends for feed intake, average daily gain, mid-test weight and residual feed intake in a population of Angus cattle selected for feed efficiency. D. P. Kirschten*[1], E. J. Pollak[1], D. R. Strohbehn[2], and D. Warden[3], [1]*Cornell University*, *Ithaca, NY*, [2]*Iowa State University*, *Ames*, [3]*Wardens Farm*, *Council Bluffs, IA*.

Wardens Farm of Council Bluffs, IA provides Angus bulls to area purebred and commercial breeders and AI companies. In business since 1964, Wardens Farm has tested yearling bulls for feed efficiency (FE) since 1981, accumulating feed intake (FI) records on over 450 animals. Wardens Farm uses a multiple trait approach to yearling bull evaluation with independent culling levels. Selection criteria are: weight per day of age (off test): > 1.36 kg, frame score: < 6.5, Ultrasound (US) fat thickness: < 1.02 cm, US intramuscular fat: > 3.0%, US ribeye area: > 80.6 cm2, FE ratio: > 100, birth weight: < 43 kg, and scrotal circumference: > 36 cm. Genetic parameters for FI, average daily gain (ADG), mid-test weight (MW) and residual feed intake (RFI) were estimated using records from 309 bulls with a pedigree population of 782 animals. Animals born before 1991 were not included in the genetic trend charts. Genetic trends for FI and RFI were variable until key sires were identified through progeny testing that were favorable for FE, while at the same time several sires were identified that were unfavorable for FE and were culled which allowed genetic trends to become evident. Also, increased capacity to measure FI in recent years has resulted in rapidly decreasing trends for FI and RFI. Selection has resulted in animals with increased genetic merit for ADG and MW with increased genetic merit (decreasing trends) for FI and RFI.

Table 1. Genetic Trends for Feed Intake, Residual Feed Intake, Average Daily Gain and Mid-test Weight, kg

Year	FI	RFI	ADG	MW
1991	-0.054	-0.008	0.002	0.09
1992	-0.057	-0.055	0.00	-1.15
1993	-0.143	-0.105	0.006	1.71
1994	-0.055	-0.064	0.01	1.16
1995	0.017	0.031	0.009	4.41
1996				
1997	0.00	-0.086	0.025	6.55
1998				
1999	0.042	-0.051	0.015	9.96
2000	-0.104	-0.187	0.00	7.47
2001	-0.069	-0.127	0.051	3.99
2002	0.039	-0.104	0.021	10.52
2003	-0.68	-0.217	0.081	9.90
2004	-0.182	-0.313	0.057	10.31

Records previous to 1991 and for the years 1996 and 1998 were not available for analysis.

Key Words: Feed Intake, Feed Efficiency, Beef Cattle

935 Relationship between residual feed intake and ultrasonic measures of body composition in yearling performance tested bulls. T. L. Perkins*, J. L. Drury, and A. Rimal, *Missouri State University*, *Springfield*.

Feed input is the greatest cost in livestock production. Residual feed intake is a measure of growth that can be used to select breeding animals, to reduce feed cost. Residual feed intake compares actual consumption and estimated feed consumption. Low or negative RFI values are present in animals that are efficient feed converters. The objectives of this study were to examine the relationship between residual feed intake (RFI) and ultrasound measurements taken at yearling weigh off period in performance tested bulls. One hundred forty-four registered bulls (n=144) were scanned ultrasonically for ribeye area (REAU), fat thickness (FTU), and percent fat (%FatU) at the conclusion of a 112 d feed test. The cattle used in this study were from the Greensprings Bull Test Station in Nevada, Missouri. Ultrasound measurements were taken at approximately one year of age at the end of the 112 d weigh off. All ultrasound measurements were taken by an Ultrasound Guidelines Council (UGC) field and laboratory certified technician using the Beef Image Analysis (BIA) image capturing software. All captured images were sent to and interpreted by the National CUP Lab in Ames, Iowa. Means and standard deviations for 112 d measures for on test weight (ONWT), off test weight (OFFWT), RFI, REAU, FTU, and %FatU were 384.95 ± 57.36 kg, 577.95 ± 63.30 kg, -0.20 ± 2.14, 93.87 ± 12.21 cm^2, 0.76 ± 0.26 cm, and 4.07 ± .87 %, respectively. Pearson correlations between RFI and OFFWT, REAU, FTU and %FatU 0.03, 0.08, 0.22 and 0.18, respectively; whereas, the correlation between RFI and feed consumption (KG FEED) was higher and more significant at 0.55. These coefficients indicate that RFI is a better indicator of yearling fat measures (FTU and %FatU) than muscle (REAU).

Key Words: Ultrasound, Residual Feed Intake, Bulls

936 Characterization of residual feed intake and relationships with serum insulin-like growth factor-I in growing Brangus heifers. P. A. Lancaster*[1], G. E. Carstesn[1], J. G. Lyons[1], T. H. Welsh, Jr.[1], R. D. Randel[2], and T. D. A. Forbes[3], [1]*Texas Agricultural Experiment Station*, *College Station*, [2]*Texas Agricultural Experiment Station*, *Overton*, [3]*Texas Agricultural Experiment Station*, *Uvalde*.

The objective of this study was to characterize residual feed intake (RFI) and examine phenotypic correlations with serum insulin-like growth factor-I (IGF-I) in growing heifers. Average (± SD) initial age and BW of Brangus heifers (Camp Cooley Ranch) were 225.8 ± 9.1, 236.0 ± 10.7 and 235.6 ± 14.6 d, and 285.1 ± 28.0, 268.5 ± 23.8 and 267.8 ± 25.8 kg for year 1 (N=114), 2 (N = 115) and 3 (N = 119), respectively. Heifers were individually fed a roughage based diet (ME = 2.1 Mcal/kg DM) using Calan gate feeders for 70 d. Weekly BW were measured and ultrasound measures of 12th rib fat thickness (BF) and longissimus muscle area (LMA) obtained at d 0 and 70. Whole blood was collected at weaning, and at d 0 and 70 of the intake measurement period, and serum assayed in duplicate aliquots for IGF-I by EIA procedures (IDS, Inc., Fountain Hills, AZ). RFI was computed as actual minus predicted DMI, with predicted DMI determined by linear regression of DMI on mid-test BW$^{.75}$ and ADG with year as a random effect using a variance component covariance structure (R2 = 0.57). Overall ADG, DMI and RFI were 0.90 ± 0.15, 1.06 ± 0.16 and 1.00 ± 0.13 kg/d, 9.10 ± 1.11, 9.47 ± 1.04 and 9.92 ± 1.06 kg/d, and 0.00 ± 0.75, 0.00 ± 0.68 and 0.00 ± 0.70 kg/d for year 1, 2 and 3, respectively. ADG was strongly correlated with FCR (-0.67), but not with RFI, whereas, DMI was correlated with both RFI (0.67) and FCR (0.17). In addition, RFI was strongly correlated with FCR (0.60). Heifers with low RFI (< 0.5 SD; n = 112) consumed 16% less (P < 0.01) DMI and had 15% lower (P < 0.01) FCR than heifers with high RFI (> 0.5 SD; n = 98), even though ADG and final BW were similar. Overall IGF-I concentrations were 113.3 ± 27.4, 121.0 ± 29.6 and 116.6 ± 28.7 ng/ml for weaning, d 0 and d 70 sampling times. RFI was not correlated with IGF-I concentration at any of the sampling times. However, weaning IGF-I concentration was weakly correlated (P < 0.05) with ADG (-0.11) and final BF (0.11) and LMA (0.17), but not with DMI or FCR. These data suggest serum IGF-I concentration may be indicative of growth, but not feed intake or efficiency in Brangus heifers.

Key Words: Residual Feed Intake, IGF-I

937 Feed efficiency and residual feed intake of Nelore young bulls selected for yearling weight. R. Almeida*[1], R. F. Nardon[2], A. G. Razook[2], L. A. Figueiredo[2], and D. P. D. Lanna[3], [1]*Universidade Federal do Paraná*, *Paraná, Brazil*, [2]*Instituto de Zootecnia*, *São Paulo, Brazil*, [3]*ESALQ/USP*, *São Paulo, Brazil*.

A Nelore herd at the Sertãozinho Experimental Station, São Paulo, Brazil has been selected for yearling weight for more than 25 years. The feedlot test used 72 young bulls from the 12-13-14th progenies of the Selection Program for Zebu Breeds. Thirty-six intact males from the Selected Nelore (NeS) line and 36 from the Control Nelore (NeC) line, with the same initial age of 13 months, were transferred to the feedlot and fed a high roughage diet and slaughtered at a similar age (19 months). Predicted DM intake and residual feed intake (RFI) were calculated from average intakes regressed on metabolic mid-test body weight, average daily gain and 9-11th rib fat content. RFI mean was 0.00 ± 0.41 kg/d, with minimum and maximum of -0.73 and +0.95 kg/d. Results confirm there is considerable variability for this trait in *Bos indicus*. NeS young bulls were heavier (P<0.01) at the beginning and at the end of the trial and grew faster (P<0.01) than NeC. NeS bulls had greater (P<0.01) DM intakes than NeC bulls: 8.18 vs 7.03 kg/d and 92.5 vs 87.5 g/kg BW$^{0.75}$. DMI expressed as a % of BW was not different (P>0.10) between NeS and NeC lines (2.08 vs 2.03% BW). When efficiency was analyzed as feed conversion, there were no (P>0.10) differences between the two lines. However, for RFI the NeS young bulls were less eficient and ate 0.263 kg/d more (P<0.05) than NeC. There were no (P>0.10) differences for EBW fat content between the two lines, compared at the same age, but NeC were much lighter than NeS (428 and 481 kg, respectively). Consequently, the estimated energy retained was similar (P>0.05): 5.23 and 5.27 Mcal/kg EBWG, respectively for NeC and NeS. While NeS young bulls retained 11.7% more energy per day, their heat production was 17.9% larger than NeC. Thus, NeS bulls had greater (P<0.10) maintenance requirements than the control line: 78.6 and 68.0 kcal/kg BW$^{0.75}$, respectively. In conclusion, results suggest that selection for yearling weight may increase heat production and maintenance requirement. Is is also shown that selection changes RFI, but it does not change feed conversion efficiency, when animals are fed to the same fat endpoint.

Key Words: Feed Conversion, Zebu Breed

Breeding and Genetics - Livestock and Poultry: Analyses and Methods II

938 Genetic parameters estimation for Test Day Model evaluation in Italy. F. Canavesi* and S. Biffani, *ANAFI*, *Cremona, Italy*.

In November 2004 the first Italian genetic evaluation based on Test day random regression model (TDRRM) was published. The model is a Multiple-Trait-Multiple-Lactation model including four traits and three lactations for each trait. The four traits evaluated are milk, fat and protein kg and somatic cell counts. Genetic parameters used in the current model were estimated in 2003 (Muir et al, 2007). The estimated parameters were close to the parameters estimated for the same model in Canada. Heritability was close to the one used for the Lactation Repeatability model used in the past for official evaluations. Genetic correlations within trait and across traits were very similar to the parameters estimated for the same model in Canada. Research is ongoing in order to improve the stability of proofs over time and the predictive ability of the model. Pre adjustment of test day for number of days of pregnancy and the inclusion of the effect of single years in the fixed effect structure showed better results in residual analysis and a slight reduction in proof variability. The new model with pre-adjusted data was used to estimate genetic parameters with a four and three traits analysis. The three trait analysis did not consider somatic cell count. Estimations of genetic parameters of variances and covariances for the two models were achieved by Bayesian methods using the Gibbs sampler as described by Jamrozik and Schaeffer (2003). The four traits analysis resulted in very similar correlation within and across traits and a lower heritability (0.25) than the current used (0.30). The three traits analysis resulted in a higher correlations within traits across lactations very similar to correlations from single trait analysis (Muir, 2004) which may lead to a decrease in variability of proofs from run to run. Correlations between first and second lactation increased by about 0.06 and correlations between first and third lactation increased by 0.10. The new parameters are under test to verify their impact on stability of proofs.

Key Words: Genetic Parameters, Test Day Model, Multiple Trait

939 Use of a mathematical computer model to predict feed intake in Angus cattle: Genetic parameters between observed and predicted values, and relationships with other traits. D. P. Kirschten*, E. J. Pollak, and D. G. Fox, *Cornell University*, *Ithaca, NY*.

The objectives of this study were to investigate the suitability of using dry matter required (DMR) as predicted by the Cornell Value Discovery System (CVDS) in genetic evaluations and to determine relationships between model predicted and individual DMI and other traits. Group 1 (659 finishing steers) and group 2 (309 yearling bulls) had observed feed intake (FI) records. Group 3 (1586 yearling bulls and heifers) had pedigree ties to the other datasets, but did not have FI data. The data also contained records of ADG and body weight (BW). Two predictions of DMR were made with the CVDS model iterating on BW (DMR-W) and ADG (DMR-G). For purposes of parameter estimation, CVDS DMR predictions were considered surrogates for FI. Genetic parameters were estimated with MTDFREML, using an animal model with fixed effects of weaning weight contemporary group and pen. Phenotypic correlations between FI and DMR-W and DMR-G were 0.69 and 0.71. The phenotypic correlation between DMR-W and DMR-G was 0.98. Genotypic correlations between FI and DMR-W and DMR-G were 0.79 and 0.85. The genetic correlation between DMR-W and DMR-G was 0.97. Heritabilities for FI, DMR-W and DMR-G were 0.42, 0.31 and 0.33, respectively. Genetic correlations between ADG and FI, DMR-W and DMR-G were 0.45, 0.80, and 0.83, respectively. Genetic correlations between mean body weight (MW) and FI, DMR-W, and DMR-G were 0.50, 0.64 and 0.58, respectively. Residual feed intake (RFI) was calculated using FI, metabolic MW ($MW^{0.75}$) and ADG. The heritability of RFI was 0.36. The phenotypic correlation between RFI and FI was 0.57. Phenotypic correlations between RFI and MW and ADG were not estimated. Genetic correlations between RFI and FI, MW, and ADG were 0.77, 0.09, and 0.01, respectively. Heritabilities of ADG and MW were 0.27 and 0.48. Standard errors for all genetic correlations were less than 0.06. The genetic relationships between FI, DMR-W and DMR-G suggest that CVDS predictions of FI may be used as surrogates for actual FI in genetic evaluations.

Key Words: Feed Intake, Mathematical Models, Beef Cattle

940 Computing options for genetic evaluation with a large number of genetic markers. S. Tsuruta, I. Misztal*, and J. K. Bertrand, *University of Georgia*, *Athens*.

Test data set included records on about 110,000 animals for 11 growth, reproduction and other traits. Also available were marker genotypes or marker probabilities on 78 markers. The model included the effects usually fitted for these traits plus two covariables per marker; only selected markers were fit for each trait. Computing was by program blup90iod, which uses iteration on data using a preconditioned conjugate gradient algorithm with a diagonal preconditioner. Without the markers in the model, the evaluation finished in 421 rounds and 2.5 h. With the markers included, the evaluation took one week of computing and 797 rounds of iteration. Modifications included the algorithm by Strandén and M. Lidauer (SL) to reduce the number of operations for each record, a block preconditioner for traits (BT), and a block preconditioner for all markers (BM). With the markers included in the model, the number of rounds (computing time) were 797 (7.8 h.) for SL, 544 (6.2 h) for SL+BM, 459 (4.3 h) for SL+BT, and 431 (5.2 h) for SL+BT+BM. The memory requirements for all methods except BT were around 60 Mbytes; with BT, the memory requirements increased 10 times. The most important modification to decrease the computing time was the SL algorithm. Setting up BM was computationally demanding, and would be very expensive if the number of markers is increased. BT would show greater advantage with higher genetic correlations among traits. With careful programming, adding markers fitted as covariables to a genetic evaluation increases the computing time only a few times.

Key Words: Genetic Evaluation, Genetic Markers, Molecular Information

941 Sampling genotype configurations in large complex pedigree. M. Szydlowski*[1] and N. Gengler[1,2], [1]*Gembloux Agricultural University*, *Gembloux, Belgium*, [2]*National Fund for Scientific Research*, *Brussels, Belgium*.

Efficient genotype samplers are needed for Bayesian and maximum-likelihood analysis of complex genetic problems implemented via Markov Chain Monte Carlo (MCMC) algorithms. The examples of such analysis include polygene mapping in complex pedigrees and prediction of total genetic value using genome-wise dense marker maps. For large complex pedigree sampling from desired probability is impossible. We present a simple method to sample genotype configurations for large pedigree from approximate probability. The sampler uses combination of exact (simple peeling) and iterative methods (iterative peeling) to approximate target probability. Two techniques were applied to reduce computational burden: genotype elimination and set-recoding of alleles. The new sampler was evaluated on a large complex pedigree using simulated data sets for various experimental designs and degree of marker polymorphism. The pedigree used in simulation was real bovine pedigree of 907 903 animals born between 1960 and 2005 derived from Belgian dairy and dual-purpose cattle database. Four types of experimental designs were considered: (i) genotyping sires only, (ii) genotyping dams only, (iii) genotyping half of the dams but no sires, and (iv) genotyping half of the sires and half of the dams. For hypothetical single nucleotide polymorphism the new sampler reached 100%, 100%, 44% and 89% of maximum efficiency for the four experimental designs respectively. For microsatellite polymorphism the efficiency of the sampler reached 100%, 100%, 32% and 76%, respectively. To exemplify the use of the new sampler it was applied to estimate genes shared identical by descent (IBD). The calculation of genes shared IBD among relatives is an important component of gene mapping in complex diseases and quantitative traits. The convergence diagnostic methods gave indirect evidence of irreducibility of the new sampler and showed its good mixing performance.

Key Words: MCMC Sampler, Genotype Estimation, IBD

942 Comparisons of single and multiple trait random regression models for analyses of multi-parity test-days. S. Tsuruta* and I. Misztal, *University of Georgia*, *Athens*.

The objective of this study was to compare a single-trait (ST) test day model with combined covariance functions for DIM within lactation

and for across parities with a multiple-trait (MT) test day model with random regressions on DIM treating each parity as a separate trait. Analyses involved records on 50,494 Holstein cows calved from 1993 to 2003 in Georgia. The data contained 495,455 test day records from first to third parities. The number of animals in the pedigree file was 118,281. The MT model for each trait (parity) included herd-test-date, age × month of calving group, milking frequency and cubic regressions on DIM using Legendre polynomials as fixed effects, and random effects of additive genetic, permanent environmental with cubic random regressions on DIM and residual. The ST model included the same fixed and random effects as the MT model except for additive genetic and permanent environmental effects with cubic random regressions on DIM within lactation and quadratic random regressions on parities. The MT model required 288 parameters and the ST model required 72 parameters. Variance components were estimated using an MCMC approach. Breeding values were obtained using the preconditioned conjugate gradient algorithm with iteration on data. With the MT model, heritability estimates were 0.22, 0.19 and 0.23 on average for first, second and third parities, respectively. With the ST model, those estimates were 0.21, 0.17 and 0.21, respectively. Correlations of EBV between MT and ST models at 65 (245) DIM were 0.99 (0.98) for first parity, 0.98 (0.97) for second parity and 0.94 (0.96) for third parity. Correlations of EBV between MT and ST models averaged over 5-305 d were 0.99, 0.99 and 0.98 for first, second and third parities, respectively. The MT model required 2 times of computing time and memory for the ST model. Results of tests with larger data sets will be presented. The ST test day model as presented may be a cost-effective alternative to the MT test day model.

Key Words: Test Day Model, Random Regressions

943 Investigation of genetic differences in feed efficiency through comparison of observed versus model predicted feed intake in *Bos indicus – Bos taurus* F_2 full sib steers. T. S. Amen*, J. E. Sawyer, A. D. Herring, J. O. Sanders, D. K. Lunt, and C. A. Gill, *Texas A&M University*, *College Station*.

Individual feed intake (DMI) and body weight were measured on 149 F_2 Nellore-Angus steers born and raised at the Texas A&M University Experiment Station at McGregor. Steers belonged to 12 full sib embryo transfer families sired by 4 bulls and from 11 dams born in the spring and fall of 2003 to 2005. At approximately 12 months of age, steers were placed on feed for an average of 140 d with individual intake measured using Calan gates. Using the NRC (2000) model, daily feed intake was predicted based on observed weight gain for each animal and standardized input for animal type, age, sex, condition, and breed. This model predicted intake (MDMI) was then subtracted from observed DMI and the difference defined as model predicted residual consumption (MPRC) such that those animals that consumed less than predicted (and thus, were more efficient) had negative MPRC. This method was utilized instead of traditional residual feed intake in order to make simultaneous use of data from multiple contemporary groups. Mixed procedures of SAS were then used to analyze MPRC with fixed factors of sire and family nested within sire. Initial analysis also included contemporary group; however, substantial imbalance existed with sire and family, so it was subsequently omitted. Sire ($P = 0.016$) and family(sire) ($P < 0.001$) both accounted for variation in MPRC. Least squares means for MPRC by sire ranged from a low of -0.51 ± 0.22 kg day $^{-1}$ to a high of 0.65 ± 0.36 kg day $^{-1}$. Least squares means for MPRC by family(sire) ranged from -2.13 ± 0.48 kg day $^{-1}$ to 1.45 ± 0.60 kg day $^{-1}$ across families. Variation between sires and families for MPRC indicates that genes affecting this trait are segregating in this population and presents future opportunities for QTL analysis, and subsequent gene discovery; further, MPRC holds promise as a model derived method of evaluating efficiency across contemporary groups.

Key Words: Predicted Intake, NRC Model, *Bos indicus*

944 First screening of QTL using a segment mapping approach. M. Sargolzaei*[1], F. Schenkel[1], and H. D. Daetwyler[2], [1]*University of Guelph*, *Guelph, Ontario, Canada*, [2]*Roslin Institute*, *Roslin, Midlothian, Scotland, UK*.

Panels of SNP markers are rapidly increasing in size and are being used for fine mapping. The first step in fine mapping is to identify potential regions which are more likely to harbor QTL. The objective of this study was to evaluate a modified version of the segment mapping method (SM) for a first screening of QTL using simulated SNP data. The SM included the polygenic effect, the putative QTL effect and the whole chromosome effect excluding the putative QTL. The SM was compared to the point identity by descent (IBD) method (PM), in which only the polygenic effect and the putative QTL effect were fitted, using 4 simulated generations of randomly mated sires (15) and dams (300; 1 progeny per dam). A trait with heritability of 0.3 was considered. A 1-Morgan chromosome with 100 evenly spaced SNPs was simulated. Two bi-allelic QTL with additive effects were symmetrically located at 20, 15, 10 and 5 cM from the centre of chromosome. Each QTL explained 16.6% of total additive genetic variance. In every generation, 50% of the oldest sires and dams were randomly replaced. The software Loki was used to compute IBD at every cM. For SM, the average of 99 point IBDs was used as an approximation of IBD for the rest of chromosome. The full models, with putative QTL included, were tested against the corresponding models with no putative QTL, using the software ASReml. The likelihood ratio peaks for the QTL positions given by SM were always narrower and clearer than PM. However, when the two QTL were located less than 20 cM apart, both SM and PM revealed a single peak. The SM seemed to separate loosely linked QTL better than PM. Thus, SM might be useful for first screening of QTL, but the number of QTL, their precise positions and effects should be estimated by fine mapping methods in a second step.

Key Words: First Screening, QTL, Segment Mapping

945 Evaluating the feasibility of fitting haplotype effects as random: Variance component estimation. L. A. Kuehn*, R. M. Thallman, and K. A. Leymaster, *USDA-ARS U.S. Meat Animal Research Center*, *Clay Center, NE*.

Fitting haplotypes as random effects in association studies may prevent overestimation of haplotypic effects with low frequencies. The objective was to determine whether haplotypic variance could be accurately estimated. Using simulation, haplotypic effects were deterministically assigned to either 2 or 16 haplotypes with variances of haplotypic effects set at 2, 4, or 16.67 units^2. Haplotypes were

assigned stochastically to base animals in frequencies such that the 3 haplotypic variance scenarios accounted for 3, 6, and 25 units^2 of genetic variance, respectively. Polygenic additive effects were assigned from a normal distribution so that a total of 25 units^2 of the phenotypic variance was genetic. Residual effects were sampled from a normal distribution with a variance of 75 units^2. Either 250 or 1,000 progeny (5 or 15 per sire) with performance records were simulated. With varying levels of haplotype number, haplotypic variance, numbers of progeny, and numbers of progeny per sire, there were a total of 24 different simulation scenarios. Each simulation scenario was replicated 100 times and analyzed using MTDFREML with a model that included a random independent regression for the number of copies of each haplotype (0, 1, or 2), a random polygenic effect, and error. Estimates of polygenic and residual variance were accurate for all scenarios. Standard errors of the mean estimates for both variance components were greater with 250 than 1,000 progeny and with 5 than 15 progeny per sire. When 16 haplotypes were simulated, the variances of haplotypic effects were accurately estimated when the pedigree contained 1,000 progeny and underestimated with 250 progeny. Haplotypic variance was consistently overestimated when only 2 haplotypes were simulated, possibly due to the small number of classes for the haplotypic regression. Large, phenotyped pedigrees are important when estimating haplotypic variance for association studies.

Key Words: Haplotype, Simulation, Variance Components

946 Interval mapping of deleterious recessive loci in half-sib families. L. Gomez-Raya* and W. M. Rauw, *University of Nevada*, *Reno*.

Deleterious recessive genes in farm species with a half-sib structure are difficult to eliminate by breeding. However, their frequency can be increased by the widespread use of semen of carriers with high genetic value. In this study, we developed maximum likelihood interval mapping methods to detect deleterious recessive genes. The methods were developed for recessive genes that are lethal in homozygotes before birth, and also in homozygotes that are born with a disease. The available DNA marker data in the first situation is that one fragment in one of the two chromosomes is inherited in a lower number of offspring than the other chromosomal fragment. For this situation, we carried out a Monte Carlo computer simulation modeling a heterozygous sire with one copy of the recessive allele and a varying number of progeny and frequency of the recessive allele among the progeny. The simulated chromosomal fragment was bracketed by DNA markers separated 20cM, with the recessive locus equally distant from each of the two markers. The percentage among 10,000 replicates with a lod score greater than 2 for 100 tested offspring were 2.69, 8.56, 23.65, and 51.05% for a frequency of the recessive allele of 0.20, 0.30, 0.40 and 0.50, respectively. The percentage of replicates with a lod score greater than 2 for a progeny size of 2000 was 21.44, 60.83, and 92.65% for allele frequencies of 0.10, 0.15, and 0.20, respectively. The average estimate of the position of the recessive locus was 0.5cM or less in all simulations. Estimates of the allele frequency of the deleterious locus were unbiased except when the frequency or the progeny group was small. The percentage of replicates that located the locus within 1cM of the simulated position was 16.9% for a progeny size of 2,000 and allele frequency of the recessive allele of 0.20. The results illustrate that large progeny groups are required to detect recessive alleles at low frequency. Mapping strategies, including selective genotyping of offspring of dams genetically related to the sire, are discussed.

Key Words: Linkage Analysis, Half-Sibs, Gene Mapping

947 Investigating the role of genetics on bovine respiratory disease incidence. M. J. Schneider*, J. R. Tait, M. V. Ruble, and J. M. Reecy, *Iowa State University*, *Ames*.

Bovine Respiratory Disease (BRD) is one of the most costly diseases facing the cattle industry. Therefore, the objective of this study was to examine the role genetics has on susceptibility and resistance to bovine respiratory disease. Calving, pedigree, and health treatment records were collected on 1400 cattle born from 1997 through 2006 at the Iowa State University beef teaching farm with majority of cattle sired by Angus or Simmental bulls. Calves were born in both the Spring and Fall seasons for each year with the exception of 2006 where only Spring calves were used. The number of treatments for BRD varied with 80% of cattle never being treated for respiratory symptoms, 16% treated once, 3% treated twice, and 1% treated three to five times. The highest incidence of BRD treatment occurred in calves born in the Spring of 2001 when 74.8% of calves were treated at least once, whereas the lowest incidence of treatment occurred in calves born in the Fall of 2003 (1.5%). Statistical analysis was performed using general linear models to estimate significance level and effects. Traits showing significant effects ($P<0.05$) on the number of times an animal was treated for BRD included sire nested within breed, calving season group, and birth weight these accounted for 28.4% of the variation in number of BRD treatments. Calving ease score and sex did not have a significant effect on the number of treatments for BRD ($P>0.10$). LSMeans estimates of sire effect for number of respiratory treatments within Angus ranged from -0.22 to 1.96 and in Simmental ranged from -0.06 to 1.77. The results from this study show a significant effect on number of treatments for BRD among sires within breeds. Thus, further investigation into the genetic control of BRD is warranted.

Key Words: Bovine Respiratory Disease, Genetics, Beef Cattle

948 Simulation study controlling inbreeding in litter size. S.-H. Oh*[1], G.-M. Kim[1], and Y.-C. Jung[2], [1]*North Carolina A&T State University*, *Greensboro*, [2]*Jung P&C Institute*, *Seongnam, Gyeonggi, South Korea*.

Inbreeding is the mating of relatives that produces progeny having more homogenous alleles than non-inbred animals. Inbreeding causes an increase of recessive alleles, which is often associated with a decrease in performance, known as inbreeding depression. The magnitude of inbreeding depression depends on the level of inbreeding expressed by coefficients. Litter size is a quantitative trait compound of effects from two generations. The number of pigs born in a litter depends partly on the dam and partly on the offspring of the dam. Therefore both the dam's fertility and the litter's viability influence litter size at the same time. The fact that the inbreeding rate of young in the litter is always one step ahead of that of the dam seems to be more of an influence of the litter on reduction of litter size. One of breeding goal in livestock is uniform productivity which means uniform progeny from homogenous

parents, maintaining optimal inbreeding level, especially keeping inbreeding lower than 20%. The concept of the theory of optimum genetic contribution (OGC) uses the relationships between individuals as weights. The objective of this study was to compare simulated results of the OGC algorithm in different conditions for 30 generations. Results showed this algorithm could effectively control inbreeding maintaining a consistent increase in selection responses. The difference of breeding values between selection based on the OGC algorithm compared with with EBV was only 13%, but the rate of inbreeding could be controlled as much as ~67% after 30 generations, indicating that the OGC algorithm can be effectively used for long-term selection programs.

Key Words: Inbreeding, Simulation, Litter Size

Contemporary & Emerging Issues - Livestock and Poultry: Contemporary and Emerging Issues

949 Avian H5N1: Still an animal virus? F. C. Leung*, *The University of Hong Kong*, *Hong Kong, HK-SAR, China*.

As of Feb 6, 2007, the cumulative number of confirmed human cases of avian influenza A/(H5N1) reported to World Health Organization (WHO) is 272 with 166 deaths. Avian influenza including H5N1 refers to a large group of different influenza viruses of which the primary host is birds. Only on rare occasions do these viruses cross over and infect other species including pigs and humans. Pandemic influenza happens when a new subtype emerges that has not previously circulated in humans. Since H5N1 is a strain of such potential, WHO and other health experts, for this reason, have been priming the world to prepare for this threat along with OIE and FAO calling for culling million of poultry world-wide. During my presentation, I will present a model based on the most recent event of an animal virus 'crossing over' to become a human virus, SARS, and argue that the scale of the warnings appears to outstrip the magnitude of the real threat. Culling millions of chicken may not have actually lowered the actual risk and efforts and resources should be directed to research in understanding the molecular and genetic mechanisms underlying the virus-crossing species event. Only then can effective barriers be set up to limit the direct contact of susceptible species; to lower the transmission rate; and avoid establishing/adaptation to a new host. In addition, I shall review recent scientific findings that avian H5N1 remains as an animal virus and the probability and possibility for H5N1 successfully adapting to humans as a new host remains low at this particular moment!

i**Key Words:** Avian Influenza, H5N1, Virus

950 Bovine spongiform encephalopathy in the United States. J. A. Richt*, *National Animal Disease Center-ARS-USDA*, *Ames, IA*.

Transmissible spongiform encephalopathy (TSE) agents or prions induce fatal neurodegenerative diseases in humans and in other mammalian species. They are transmissible among their species of origin, but they can also cross the species barrier and induce infection with or without disease in other species. In animals, four distinct TSE diseases are recognized: scrapie in sheep and goats, transmissible mink encephalopathy (TME) in mink, chronic wasting disease (CWD) in cervids, and bovine spongiform encephalopathy (BSE) in cattle. BSE was first identified as a TSE of cattle in the mid 1980s in the U.K. and more than 180,000 positive cases have been diagnosed in the U.K. to date. Using epidemiological surveillance programs, many European and non-European countries have discovered BSE-positive animals within the last decade. In the U.S., the first BSE case (case 1) was identified in December 2003; this animal was determined to be imported from Canada. After this animal was identified, the USDA began its enhanced BSE surveillance program in June 2004. Since then, two additional animals (cases 2 and 3) have been identified as being positive for BSE. Both animals were born and raised in the U.S. Case 1 showed molecular features similar to typical BSE isolates, whereas cases 2 and 3 revealed unusual features referred to as atypical BSE isolates. Unusual cases of BSE are an unexpected finding since it was previously believed that BSE disease in cattle is caused by a single strain of infectious agent, which has been shown to be very consistent and uniform in appearance, even after transmission to other species. The appearance of unusual phenotypes of BSE in cattle suggests that different BSE strains exist in cattle.

Key Words: Prion Diseases, U.S BSE Cases, BSE Strains

951 Scenario and economic analysis of a hypothetical link between MAP and Crohn's disease. H. Groenendaal* and F. Z. Zagmutt, *Vose Consulting*, *Boulder, CO*.

Johne's disease (JD) is an infectious disease of cattle caused by the agent Mycobacterium avium subspecies paratuberculosis (MAP). Crohn's disease is a disease of unknown etiology that causes chronic bowel inflammation in humans. No causal link between MAP and Crohn's disease in humans has been scientifically established but given the potential for such discovery, it is important to understand its possible impacts on society. In this presentation, we will show the implications and the possible economic impacts on the dairy industry and to provide a framework for further discussion among stakeholders. Three scenarios were developed based on the effectiveness of possibly risk mitigation strategies. In the first scenario, it was assumed that an effective strategy would exist, resulting in negligible demand effects. In the second scenario it was assumed that new risk mitigation would need to be implemented, in which case a small milk demand was expected, with the potential of being large. The third scenario assumes that no fully effective risk mitigation would be available, which more likely results in a considerable demand decrease and a reduction in milk supply as a result of government regulations. With milk demand of 1% or 5%, a reduction in consumer surplus of $600 million and $2.9 billion and a reduction in dairy farm income of $270 million and $1.3 billion respectively was found. The true shift in demand is however impossible to predict. An decrease in milk supply would slightly increase total losses, but would cause great losses to MAP positive dairy farms. Given the current scientific knowledge about the link between MAP and Crohn's and the effectiveness of risk mitigation methods, it is concluded that in case a link would be established, it is most likely that the first scenario or potentially the second scenario could occur. Consumer response and economic consequences to discovery of such link are therefore expected to be limited, but could

be large if the consumer's perception of risk turns out to be large or if risk mitigation strategies appear not fully effective.

Key Words: Mycobacterium Avium Subspecies Paratuberculosis, Crohn's Disease, Economic Analysis

952 Tuberculosis: A re-emerging disease at the interface of domestic animals and wildlife. M. V. Palmer*, *National Animal Disease Center, ARS, USDA*, *Ames, IA*.

In the early twentieth century there were large numbers of tuberculous cattle in many countries. An association was made between the number of *Mycobacterium bovis* infected humans and the prevalence of tuberculosis in cattle. Mandatory pasteurization of milk and advances in public health caused the prevalence of human tuberculosis due to *M. bovis* to decline dramatically in developed countries. However, in some countries eradication has been prevented by several factors not least of which is the presence of a wildlife reservoir of *M. bovis*. In Great Britain evidence suggests that *M. bovis* is endemic among badgers (*Meles meles*), and that tuberculous badgers are the source of infection for cattle. In New Zealand, brushtail possums (*Trichosurus vulpecula*), first taken to New Zealand from Australia in the mid-nineteenth century now occupy over 90% of New Zealand's land mass and serve as a source of *M. bovis* for domestic livestock. In Michigan, USA free-ranging white-tailed deer (*Odocoileus virginianus*) represent the first known reservoir of *M. bovis* in free-living wildlife in the United States. Deer to cattle transmission of *M. bovis* has been documented. Wildlife reservoirs of *M. bovis* represent a serious challenge to the eradication of *M. bovis*. The presence of wildlife reservoirs is the direct result of spill-over of *M. bovis* from domestic livestock and efforts to eradicate *M. bovis* from domestic livestock are impeded by spill-back from wildlife reservoirs. The test and slaughter policies of tuberculosis control, effectively used with domestic livestock, are insufficient in areas where wildlife reservoirs exist. Complete removal of wildlife is impractical, and often impossible. It will not be possible to eradicate *M. bovis* from livestock until transmission between wildlife and domestic animals is halted. Such an endeavor will require a collaborative effort between agricultural, wildlife, environmental and political interests.

Key Words: Mycobacteria, Tuberculosis, Wildlife

Nonruminant Nutrition: Poultry Nutrition - Phosphorus and Phytase

953 Early response of young breeder source broilers to combined xylanase-amylase-protease-phytase supplementation of a high performance feed and when both ME-available phosphorus (AP) are reduced. E. T. Moran* and R. Lehman, *Auburn University*, *Auburn University, AL*.

Reserve body fat and calcium-phosphorus of chicks at hatch suffer when from small eggs of young breeders. Supplemental enzymes that focused on energy and AP recovery were examined as a means to relieve early inadequacies of these source broilers. Chicks (1600; 64 pens) originating from a 26 week old R X 708 flock were either directly placed (34g/bird) in litter pens or delayed 24 hours (30 g), respective of sex. Corn-soybean meal feed for next 3 weeks was crumbed and either high performance (23% CP, 1.38% lysine, 0.98% TSAA, 3.19 Kcal ME/g, 0.44% AP, 0.99% Ca) or low ME-AP (omission of 2% fat and 0.25% dicalcium phosphate for corn: 3.11 Kcal/g, 0.34% AP, 0.87% Ca) formulations were used. Crumbed feeds were either fed "as is" or supplemented "on top" to provide units/kg of xylanase, 300; amylase, 400; protease, 4000; phytase, 5000 (0.05% Avizyme 1502 + 0.01% Phyzyme XP). The enzyme mixture did not improve gain during the subsequent 3 weeks of birds given high performance feed as much as improve F/G ($P<.05$). Low ME-AP feed adverse affected live performance that was rectified by supplemental enzymes to the same level as those receiving high performance feed with enzymes ($P<.05$). Adding enzymes also reduced within pen standard deviation of body weights, regardless of feed ($P<.05$). Delayed placement decreased body weight when placed in pens and accentuated the loss in performance from low ME-AP and benefit from enzyme supplementation. Most advantages from added enzymes were exhibited similarly by both sexes, but improved F/G was more apparent with males than females. Supplementation with feed enzymes that improve recovery of energy and phosphorus was of distinct advantage to chicks derived from young breeder hens.

Key Words: Broiler Chick, Feed Supplement, Incubation

954 The effects of supplemental Quantum Phytase on second cycle Hyline W-36 hens. M. Lilburn[1] and C. Wyatt*[2], [1]*Ohio State University*, *Wooster*, [2]*Syngenta Animal Nutrition*, *Research Triangle Park, NC*.

A flock of Hyline W-36 hens was molted using the non-feed withdrawal program developed by the University of Illinois. During the molt period, all hens were fed a diet containing primarily ground corn (23%) and wheat midds (71.1%) and the hens never completely ceased production. At the onset of second cycle production, 7 replicate blocks of hens (n=4 cages per block; 2 hens per cage) were fed one of 5 diets. The diets were a positive control containing 0.50 total phosphorus (TP), a negative control diet (NC) containing 0.28% TP and the NC diet with either 200 , 400 , or 600 units of QuantumTM phytase. All hens were limit fed 95 g/hen/d. Hen-day egg production was measured over four consecutive 28-day periods and egg weight and shell weight were determined on all eggs collected on two consecutive days during the second and last 28-d production periods. Only the data from the second 28-d period will be reported. The NC diet was numerically lower in hen-day egg production during the first 28-d compared with the mean of the PC and Quantum treatments (47.9 vs. 51.0) but the variability precluded any significant treatment differences. Over the subsequent three production periods, however, hen-day production in the NC treatment was significantly lower than the PC and Quantum supplemented treatments (Pd 2, 68.5 vs 82.0; Pd 3, 67.4 vs 79.7; Pd 4, 70.2 vs 77.3). There were no significant differences between the PC and Quantum treatments during any of the four production periods. Egg weight (63.7 vs 66.4 g) and shell weight (5.89 vs 6.08 g) were both significantly lower in the NC compared with the PC and Quantum supplemented treatments. In summary, a diet containing 0.28% TP resulted in a significant reduction in both hen-day egg production, egg weight, and shell weight compared with a diet containing 0.50% TP or the NC diet supplemented with as little as 200 units of Quantum phytase.

Key Words: Phytase, Laying Hens, Molt

955 Influence of dietary calcium and phytase source on broiler performance. T. M. Parr*, M. R. Bedford, and C. L. Wyatt, *Syngenta Animal Nutrition*, *Research Triangle Park, NC*.

Previous research has shown that bird response to fungal phytases may be linked to the level of calcium in the diet relative to phosphorus. An experiment was conducted to determine the effect of incremental doses (500 and 1000 FTU/kg diet) of a coated fungal phytase (CFP) compared with similar doses of Quantum phytase (QP; an evolved E.coli-derived phytase) on bird performance to 49d, when added to diets containing different levels of calcium. A four-phase (0-18d, 19-30d, 30-39d, and 39-49d) feeding program utilized two positive control (PC) basal diets containing either high (HPC; 1.0, 1.0, 0.95, 0.90) or low (LPC; 0.90, 0.85, 0.78, 0.72) levels of Ca, respectively. The PC diets supplied all nutrients at or above NRC requirements, with the exception of Ca in the LPC treatments. The respective negative control (HNC and LNC) diets contained 0.10% less Ca than the PC. Additionally, all NC diets were reduced by 0.13% available P, 0.029% Thr, 0.018% TSAA, 0.01% Lys, and 45kcal ME. To each negative control diet, 500 or 1000 FTU/kg of either QP or CFP was added to give 12 diets in total. Each diet was fed to 11 pens of 17 birds per pen with both feed and water being offered ad libitum. At 49 days of age, both HPC and LPC-fed birds were heavier than their NC-fed counterparts. There was a significant Ca x enzyme interaction, with birds fed QP weighing more than CFP-treated birds, as well as PC-fed birds. The addition of 500 FTU/kg QP increased intake to PC levels whereas CFP-fed birds required 1000 FTU/kg phytase. Weight corrected feed conversion (WcFCR) showed a significant interaction for Ca level x dose as well as Ca level x enzyme, indicating QP was more effective in restoring FCR than was CFP at either Ca level. When feeding high Ca levels, 1000 FTU/kg of phytase was more effective, whereas at the low Ca levels, 500 FTU/kg of either phytase had a more beneficial effect. These results indicate all phytases are more effective when Ca is not over supplied in the diet, but that QP is more efficient at restoring performance than CFP whether Ca levels in the diet are high or low.

Key Words: Calcium, Phytase, Broiler

956 Influence of dietary calcium and phytase source on litter moisture and mineral content. M. R. Bedford*[1], T. Parr[1], M. E. Persia[1], A. Batal[2], and C. L. Wyatt[1], [1]*Syngenta Animal Nutrition*, *Research Triangle Park, NC*, [2]*University of Georgia*, *Athens*.

The effects of incremental doses (500 and 1000 FTU/kg diet) of a fungal phytase (FP) was compared with that of Quantum phytase (an evolved E.coli-derived phytase; QP) on litter moisture (LM) and mineral content in a 49d grow out study utilizing a four-phase (0-18d, 19-30d, 30-39d, and 39-49d) feeding program. Birds were offered a positive control, that met or exceeded all NRC requirements (HCaPC) or a reduced Ca positive control that met or exceeded NRC requirements with the exception of Ca (LCaPC). Negative controls (HCaNC and LCaNC were generated by removing 0.13% available P, 0.1% Ca, 0.029% Thr, 0.018% TSAA, 0.01% Lys, and 45 kcal ME from the respective positive control diets. To each negative control diet, 500 or 1000 FTU of either QP or FP were added to give 12 diets in total. Each diet was fed to 11 pens of 17 birds with feed and water being offered ad libitum. At approximately day 25, it became apparent that litter quality had deteriorated in many pens. Grab samples of litter were taken immediately from each of 132 pens and analysed for moisture and mineral content. The data were analysed by ANOVA and means separated by the pdiff option of the LS means procedure. Feeding the negative control diets without phytase increased LM (30%) compared with the positive control diets. Although, feeding the LCaPC resulted in similar LM to the HCaPC (31.5 v. 33.5%), feeding the LCaNC diet resulted in significantly less LM than that of the HCaNC diet (43.5 v. 49.2%). Addition of phytase reduced LM in the HCaNC diets, but never reached the level of the HCaPC. Supplementation of the LCaNC diets with 500 and 1000 FTU of QP and 1000 FTU of FP reduced LM to the level of the LCaPC. Mineral analysis of the litter, when correlated with moisture, suggested that Zn, Ca and Na were associated with high LM whereas Mn and Cl were associated with low LM. The results suggest that LM may be influenced by feeding diets adjusted for phytase inclusion. These effects may be mitigated by manipulation of dietary mineral content.

Key Words: Phytase, Litter Moisture, Litter Minerals

957 A holo-analysis of trials investigating the gain and feed conversion ratio benefits of Quantum™ phytase supplementation to broilers under a variety of managerial, environmental and dietary conditions. M. R. Bedford*, C. Murphy, and M. E. Persia, *Syngenta Animal Nutrition*, *Research Triangle Park, NC*.

Data from a total of 77 broiler trials executed over a period of 6 years in which Quantum™ phytase (QP) and several other phytase sources were employed at dosages ranging from 25 FTU/kg to 62,500 FTU/kg were collected and collated in a database that was used to construct a comprehensive multifactorial model to describe the effect of phytase on broiler gain and FCR. Management and environmental factors, dietary ingredients and nutrient contents along with enzyme type and dosage were offered in a stepwise regression analysis ($p<0.20$ in $p>0.10$ out) of the 1032 tests available. Each test represented a response to a given dose of enzyme in any particular trial. Models for gain and FCR were generated which explained 54 and 48% of the variation, respectively. Factors which significantly influenced the FCR response to phytase included the source of the phytase (QP performing significantly better then fungal phytases), sex (females responding moreso than males), and the presence of a coccidiostat (in most cases being significant and positive). Factors influencing the gain response included the age at which the experiment started (effect being greater if the trial starts at day of age), lighting (effects diminish as lighting time increases) and the duration of the trial (longer trial gives a larger effect). Responses in both gain and FCR were best described by the logarithm of the dose of the enzyme employed rather than linear or quadratic dose terms, which suggests that phytase, unlike most other enzymes and nutrients, does not pose a risk to performance if overdosed. Indeed it suggests that technologically optimum dose for performance is considerably higher than current commercial practice. The implications of the significant factors in each model need further investigation.

Key Words: Holo-analysis, Phytase, Broiler

958 A novel rapid method for determining Quantum™ phytase activity levels in animal feeds. R. Upton*, C. Wyatt, M. Yarnall, A. Bruton, and T. Parr, *Syngenta Animal Nutrition*, *Research Triangle Park, NC*.

A new phytase (Quantum Phytase™; QP) has been selected and modified to withstand a desired thermo-tolerance range through the

feed processing system while maintaining high bio-activity in the animal. One method to demonstrate thermo-tolerance is to measure the phytase activity in the feed post-pellet to determine the critical limits in temperature tolerance. The standard method to measure phytase activity in feed is the colorimetric assay which is based on the release of P and calibrated against a P standard curve. Although it is accurate and robust, this technique is laboratory based and labor intensive. The objective of this research was to develop a rapid and reliable method to accurately determine phytase activity in complete feed samples in the field. Several methods were evaluated and an ELISA based method was determined to meet the initial requirements of being quick and reliable. The new ELISA method is based on a monoclonal antibody developed directly against the intact QP protein. Multiple studies were conducted to evaluate the thermo-tolerance of this phytase and results have shown it can survive the rigors of normal feed pelleting conditions. Further studies were performed to determine that the ELISA measures the active phytase protein levels by using levels of phytase heated at different temperatures in feed. Results of this work demonstrated a significant positive correlation (r^2= 0.92) between the phytase activity and ELISA protein levels. These results indicate that the monoclonal is able to detect the active form of the phytase and not denatured protein. Thus, additional evaluation was completed on the ELISA method in commercial feed samples which were collected from several countries and submitted to the laboratory for activity and protein determination. Results have shown a positive linear relationship between the standard colorimetric assay and the new ELISA method (r^2 = 0.825). These data support the use of this new field based method to rapidly (less than 2 hrs) and reliably measure QP in feed samples at the feed mill laboratory.

Key Words: Phytase, ELISA, Rapid Detection

959 The interaction between dietary electrolyte balance and microbial phytase on the performance and nutrient utilization of broiler chickens. V. Ravindran*[1], A. J. Cowieson[2], and P. H. Selle[3], [1]*Massey University*, *Palmerston North, New Zealand*, [2]*Danisco Animal Nutrition*, *Marlborough, United Kingdom*, [3]*University of Sydney*, *Camden, Australia*.

The possible interaction between dietary electrolyte balance (DEB = Na + K + Cl meq/kg diet) and microbial phytase on the performance and nutrient utilization of broiler starters was examined in this study. A 4 x 2 factorial treatment structure was used with four levels of DEB (150, 225, 300 and 375 meq/kg diet) with two levels of phytase (0 and 500 U/kg; Phyzyme XP). Experimental diets were based on corn and soybean meal, and formulated to contain a non-phytate P level of 0.30%. The DEB levels were altered by the use of sodium bicarbonate and ammonium chloride. Each diet was offered to 6 replicates of 8 birds each from d 1 to 21. Increasing the DEB values from 150 to 300 meq/kg had no effect on weight gains ($P<0.05$) and feed per gain ($P<0.001$), but the gains were lowered and the feed per gain was increased at 375 meq/kg. Feed intake was unaffected ($P>0.05$) by DEB levels. Supplemental phytase improved the weight gains ($P<0.001$) and feed intake ($P<0.05$) at all DEB levels. Feed per gain was lowered ($P<0.05$) by phytase addition, but a tendency for DEB x phytate interaction ($P=0.06$) was also observed, indicating that the responses to phytase were affected by DEB level. The responses in feed per gain were greater at the lowest DEB level and phytase addition had no effect on feed per gain at the highest DEB level. DEB levels had no effect on the AMEn and ileal N digestibility to 300 meq/kg, but lowered ($P<0.001$) both parameters at 375 meq/kg. Phytase addition improved ($P<0.05$) the AME and N digestibility, but responses were observed only at the first three DEB levels and none at 375 meq/kg. The improvements in AME with 500 U/kg phytase addition in 150, 225 and 275 meq/kg DEB were 0.22, 0.25 and 0.16 MJ/ kg dry matter, respectively. The present data suggest that phytase responses are influenced by DEB levels.

Key Words: Dietary Electrolyte Balance, Phytase, Broiler Chickens

960 Energetic implications of endogenous amino acid flow at the terminal ileum of broilers as influenced by phytate and phytase. A. J. Cowieson*[1] and V. Ravindran[2], [1]*Danisco Animal Nutrition*, *Marlborough, United Kingdom*, [2]*Massey University*, *Palmerston North, New Zealand*.

The enzyme-hydrolyzed casein (EHC) method was employed to determine the effect of the ingestion of different concentrations of phytic acid, without or with microbial phytase, on the flow and composition of endogenous protein at the terminal ileum of broiler chickens. Phytic acid (fed as the sodium salt) was included in a dextrose-EHC based synthetic diet at 0.85, 1.15 and 1.45 % (or 0.24, 0.32 and 0.40% phytate-phosphorus) and each diet was fed without or with an Escherichia coli-derived microbial phytase (Phyzyme XP) at 500 FTU/kg diet. A control diet containing no phytic acid was also fed as a comparison to estimate basal endogenous flows. Ingestion of phytic acid increased ($P<0.05$) the flow of endogenous amino acids and nitrogen by an average of 47% at the lowest phytic acid concentration and 87% at the highest. The addition of microbial phytase reduced ($P<0.05$) the inimical effects of phytic acid on endogenous amino acid flow at all dietary phytic acid concentrations. The energetic implications of the changes in endogenous amino acid flow were calculated using reported gross energy values for individual amino acids. The ingestion of phytic acid increased endogenous energy loss associated with protein flow by 44kcal/kg DM intake and supplemental phytase reduced this by around 15kcal/kg DM intake. It can be concluded that phytic acid is an antinutrient capable of increasing endogenous amino acid loss and as a consequence impairing the caloric value of the diet. Further, the reported effects of phytase on amino acid and energy retention may be partially explained via a reduction in endogenous investment.

Key Words: Phytic Acid, Phytase, Endogenous Energy Loss

961 The response of chicks fed 5 corn cultivars to phytase supplementation. G. M. Pesti*, H. M. Edwards, Jr., and R. I. Bakalli, *University of Georgia*, *Athens*.

Five hybrid “non-transgenic” identity preserved corn cultivar samples from the 2002 growing season with a variety of genetic backgrounds were obtained to test the hypothesis that variation in corn may be responsible for variation in the responses to phytase supplementation observed in broiler chickens. The cultivars were grown in 3 different locations, to provide a good geographical range. The cultivars ranged from 6.6 to 7.9 % crude protein. In both experiments chicks (10 per replicate) in battery brooders were fed corn, soybean meal and soybean oil based feeds for 16 days. In Experiment 1, 3 pens per treatment were fed each of 5 cultivars with 0.46 or 0.68% total phosphorus (tP) or 0 or 12000 FTU of phytase. There were significant phytase by cultivar

interactions for the incidence of P-deficiency rickets and % tibia ash. In Experiment 2, the cultivars giving the highest and lowest growth responses to phytase when fed 0.46% tP were fed to 4 replicate pens with 18 or 23% crude protein, 0.46 or 0.68% tP and 0 or 12000 FTU of phytase. Chicks fed the 18% protein feed grew slower and had much lower incidences of P-deficiency rickets (21 vs. 14%) and improved % tibia ash (39.4 vs. 37.8%). Again, the phytase x corn interactions for P-deficiency rickets and % tibia ash were significant, but the magnitude of the differences was very small. The corn x phytase interactions could be attributed to differences in the magnitude of p-deficiency rickets between cultivars (for instance, for two cultivars chicks had 97.2 vs. 59.2 % P-deficiency rickets when fed 0.46% tP and 0 FTU phytase). When phytase supplementation reduced both values to zero, the magnitude of the reductions was different. It is concluded that there were no large differences in the responses to phytase supplementation in the 5 corn samples tested.

Key Words: Broiler Chickens, Corn Cultivars, Phytase

962 Performance and nutrient utilization in broilers fed corn-soybean based diets supplemented with coated phytase. I. A. Emiola*[1], T. A. Woyengo[1], A. Owusu-Asiedu[2], P. H. Simmins[2], W. Guenter[1], and C. M. Nyachoti[1], [1]*University of Manitoba*, *Winnipeg, MB, Canada*, [2]*Danisco Animal Nutrition*, *Marlborough, United Kingdom*.

A study evaluated the effects of a new coating (c) on the bioefficacy and nutrient utilisation of a bacterially-derived phytase product (Phyzyme XP; 6-phytase, EC 3.1.3.26) in broilers fed corn-soybean meal-based diets. Two hundred and eighty-eight day-old Ross broiler chicks, balanced for initial bodyweight (BW), were fed one of 6 dietary treatments (6 replicate cages/diet; 8 birds/cage) to 21 days of age. Diets were formulated to be isonitrogenous and isoenergetic, and Ca and available P content in the PC and NC diet were reduced from 0.78 to 0.58% and 0.41 to 0.22%, respectively. The NC diet was fed without or with supplemental phytase as follows: uncoated (u) Phytase at 500 FTU/kg; cPhytase at 500, 600 or 700 FTU/kg feed. Titanium dioxide was used as an indigestible marker. Birds fed the PC diet had higher ($P < 0.05$) feed intake (FI), BW gain (BWG), and tibia ash than those fed the NC diet. Supplementing phytase, irrespective of coating, to the NC diet increased BWG and FI ($P < 0.05$) but had no effect on FCR ($P > 0.10$). No differences in response to the two phytases tested were detected. Increasing the level of cPhytase from 0 to 700 FTU/kg linearly increased FI ($P < 0.05$), BWG ($P < 0.001$), and tibia ash ($P < 0.004$). Compared to NC diet, apparent ileal digestibility of P improved ($P < 0.05$) by 19.4 percentage units with phytase supplementation at 500 FTU/kg. Growth performance, tibia ash content, P and Ca digestibilities were not different ($P > 0.05$) for cPhytase and uPhytase, however, better ($P < 0.05$) than chicks fed the NC diet. In conclusion, the efficacy of a new coated phytase based on chick performance and nutrient utilization was similar to that of the same phytase in uncoated form indicating that the coated phytase is effectively released in vivo.

Key Words: Broiler, Phytase, Coating

963 Phytase recovery test after pelleting process in different commercial feed mills in Brazil. J. O. B. Sorbara*[1,2], J. L. Lecznieski[1], C. Arakaki[1], and F.J. Piraces[1], [1]*DSM Nutritional Products*, *Sao Paulo, SP, Brazil*, [2]*Universidade Estadual de Maringa*, *Maringa, PR, Brazil*.

Several commercial phytase products are available today. For a long time just one phytase originate from Peniophora lycii (Ronozyme™ P 5000 CT) which had thermostable characteristics based on its advanced formulation technologies. During the year of 2006, four hundred feed samples with Ronozyme™ P 5000 (CT) were collected in twenty commercial feed mills in Brazil. All those samples was collected under the same methodology and phytase recovering test was run at DSM lab in Sao Paulo. Ten feed samples with Ronozyme™ P 5000 (CT) were collected after the normal mixing time. Samples were collected as the mash emptied from the mixer, and were collected in a manner to permit samples to be equally spread based on time to empty. Pellet samples were taken as they emptied from the cooler in a manner that spread samples over the batch for equal distribution. Temperature of the pelleted feed was determined immediately at the die, time of conditioning and the amount of Ronozyme™ P 5000 (CT) added to the feed were recorded. Based on these results we can conclude that Ronozyme™ P 5000 (CT) is a very stable phytase. In additional, it is important to monitor the phytase level in pellet feed due to be affected by several factors.

Table 1. Phytase recovering test in 20 feed mill in Brazil

	Phytase Recovering (%)	Temperature (°C)	Conditioning Time (sec)
Mean	89.8	79.1	25.7
SD	10.5	5.7	10.3
CV	11.7	7.2	40.0
Min	68.8	67	13
Max	107.2	90	45

Key Words: Enzymes, Pellet, Thermostability

964 Influence of feed phosphates and phytase supplementation on broiler performance. T. Mushtaq*[1], M. Sarwar[1], G. Ahmad[1,2], M. A. Mirza[1], and M. M. H. Mushtaq[1], [1]*University of Agriculture*, *Faisalabad, Pakistan*, [2]*Shamim Feed Industries*, *Bahawalpur, Pakistan*.

The study was conducted to compare dicalcium phosphate (DCP) as phosphorus (P) source with three other phosphates i.e., bone ash, bone meal and triple-super phosphate (TSP). A low DCP diet was prepared by reducing the available P by 0.10%. The low DCP diet was divided into two portions. One portion was fed as such whereas the other portion was supplemented with phytase at 500 phytase units per kg of finished feed. Each of the 6 dietary treatment was offered to 3 replicates having 500 straight-run Hubbard broiler chicks (n = 9000). The experiment diets having 2650 kcal ME/kg and 19.7% CP were offered for 35 d. The three DCP diets depressed the BW gain during 1 to 14 ($P \leq 0.001$), 1 to 21 ($P \leq 0.001$) and 1 to 28 d ($P \leq 0.012$). Feed intake was lowered by the three DCP diets during 1 to 21 ($P \leq 0.016$), 1 to 28 ($P \leq 0.021$) and 1 to 35 d ($P \leq 0.001$). The feed:gain data revealed a depression due to the three DCP diets during 1 to 21 ($P \leq 0.001$), 1

to 28 (P≤0.01) and 1 to 35 d (P≤0.031). The BW gain, feed:gain, feed intake, mortality and foot ash were unaffected when available P was reduced by 0.10% or phytase supplementation in low DCP diets. The results of the present study demonstrated bone ash, bone meal and TSP a superior source than that of DCP. Lowering of available P by 0.10% and addition of phytase in low available P diets did not affect the growth performance or foot ash of the broilers raised on low ME and CP diets.

Key Words: Feed Phosphates, Enzyme, Broiler

Physiology & Endocrinology - Livestock and Poultry: Metabolic Physiology

965 Plane of nutrition by tick burden interaction in cattle: Effect on metabolic indicators in plasma. D. Tolleson*, G. Carstens, T. Welsh, P. Teel, O. Strey, S. Prince, K. Dean, and L. Slay, *Texas A&M University*.

Previous studies concerning the effect of external parasites on intake, performance, and metabolism in cattle utilized a single moderate quality (14% CP, 60% TDN) diet. The effects of an external parasite burden may be exacerbated in cattle grazing low quality forage. The objective of this study was to examine the interaction between plane of nutrition and a Lone Star (Amblyomma americanum) tick burden as expressed by metabolic indicators in cattle. Twenty eight growing beef steers (194 ± 3.0 kg) were randomly assigned to one of four treatments in a 2 × 2 factorial arrangement: moderate (M; 14.0 ± 1.0% CP, 60 ± 1.5% TDN) vs low (L; 7.0 ± 1.0% CP, 58 ± 1.5% TDN) plane of nutrition (PON), and control (no tick) vs tick treatment (300 pair of adult A. americanum per treated animal). Steers were individually fed M and L diets ad libitum for 35 d prior to and 21 d following the start of tick infestation (day 0), with peak tick feeding occurring on d 10 to 14. Animal weight and BCS were obtained on d -35, 0, and 21. Blood was sampled on d -7, 0, 7, 8, 9, 10, 11, 12, 13, 17 and 21. Plasma was harvested and analyzed for urea nitrogen (BUN), glucose (GLU), non-esterified fatty acids (NEFA), and beta-hydroxy-butyrate (BHBA). PON affected (P < 0.01) BUN and GLU but not (P > 0.1) BHBA and NEFA. The effect of day was significant (P < 0.01) for BUN, BHBA and NEFA but not (P > 0.1) GLU. Across PON, tick burden did not affect (P > 0.1) any constituent. A model containing BUN, GLU, and NEFA at d 12 and 21 described 54.9, 66.4, and 75.5 % of the variation in d 21 BCS, d 21 weight and d 0 to d 21 average daily gain (P < 0.01). PON but not tick burden affected metabolism of growing beef steers.

Table 1. Effect of tick treatment and plane of nutrition on metabolic indicators in cattle (mean, SE).

Constituent	Tick		Control		Moderate		Low	
BUN	4.91	0.20	5.05	0.22	7.01	0.15	2.89	0.08
GLU	95.24	1.23	96.72	1.04	101.42	1.13	90.38	0.95
BHBA	473.39	15.03	426.49	12.97	455.37	14.13	444.36	14.20
NEFA	0.27	0.01	0.24	0.01	0.25	0.01	0.26	0.01
	MT		MC		LT		LC	
BUN	6.83	0.21	7.19	0.21	2.97	0.12	2.82	0.12
GLU	102.85	1.25	100.01	1.87	87.52	1.71	93.28	0.68
BHBA	482.45	19.65	428.65	19.93	464.21	22.87	424.24	16.57
NEFA (meq/l)	0.25	0.01	0.25	0.01	0.30	0.02	0.22	0.01

Key Words: Tick, Plane of Nutrition, Metabolic Indicator

966 Using serum components and ultrasound measurements at weaning to predict feedlot gain and carcass merit. J. S. Thurlow*[1], T. L. Perkins[2], S. T. Reiter[1], A. H. Brown Jr.[1], and C. F. Rosenkrans Jr.[1], [1]*University of Arkansas*, *Fayetteville*, [2]*Missouri State University*, *Springfield*.

The objective of this study was to determine if weaning characteristics could be used to predict subsequent feedlot gain and carcass composition. The following items were collected at weaning and used as predictor variables: lactate dehydrogenase (LDH) activities, lactate, cortisol, insulin-like growth factor I (IGF-I), and prolactin concentrations and ultrasound measurements. Forty-six crossbred steers (203 ± 1.7 kg) were weaned (216 ± 2.6 d) and blood samples collected. Calves were weighed every 21 d and ADG calculated. Longissimus dorsi muscle area (REAU and REAU2), rib fat thickness (FTU and FTU2), intramuscular fat (IMFATU and IMFATU2), and rump fat (RUMP) were determined using ultrasonic measurements at weaning and at d 57 of the feedlot phase. Hot carcass weight (HCW), rib fat thickness (RF), longissimus dorsi muscle area (REA), marbling score (MARB), yield grade (YG), and quality grade (QG) were determined at harvest. Weaning FTU correlated with YG (r = 0.28; $P < 0.05$), and weaning REAU correlated with HCW and REA (r = 0.55 and 0.60; $P < 0.01$). Lactate concentrations at weaning tended ($P < 0.10$) to be negatively correlated with YG (r = -0.27). Serum activity of LDH tended ($P < 0.10$) to be negatively correlated (r = -0.25) with MARB. Serum IGF-I concentration correlated with REAU2 and FTU2 during the feedlot phase (r = 0.29 and 0.41 respectively; $P < 0.05$), and HCW, REA, and RF at harvest (r = 0.40, 0.38, and 0.39; $P < 0.01$). Serum components and ultrasound measurements at weaning did not accurately predict feedlot gain. However, weaning measurements of lactate concentration, serum LDH activity, and ultrasound measurements may be useful in predicting carcass composition.

Key Words: Feedlot, Carcass Composition, Ultrasound

967 Use of infrared thermal imaging to measure changes in body temperature following lipopolysaccharide (LPS) administration in hair sheep ewes. R. W. Godfrey*[1], R. C. Ketring[1], and S. T. Willard[2], [1]*University of the Virgin Islands, Agricultural Experiment Station*, *St. Croix, US Virgin Islands*, [2]*Mississippi State University*, *Mississippi State*.

Previous work in our lab has shown a high correlation of rectal and vaginal temperature (RT and VT, respectively) with maximum eye temperature (MAX) measured using digital infrared thermal imaging in hair sheep ewes. The objective of this study was to evaluate the relationship of VT, RT and MAX in hair sheep ewes after the administration of LPS to induce a febrile state. Rectal temperatures

and infrared images of the right and left eyes of each ewe were taken at -12, -1, 0, 1, 2, 3, 4, 6, 12, 24, 36 and 48 hr. Temperature data loggers, programmed to record at 5-min intervals, were inserted into the vagina of each ewe at -12 hr and removed after the 48 hr sample collection. At 0 hr ewes were administered saline (CONT; n = 7; 0.5 mL i.v.) or LPS (n = 7; 0.2 ug/kg BW i.v.). Infrared images of the right and left eye were analyzed to obtain an average MAX for each ewe at each time point. Analysis consisted of measuring the change in RT, VT and MAX over time and determining the correlation among RT, VT and MAX. Ewes given LPS had higher ($P < 0.008$) RT and VT than CONT ewes from 1 hr after treatment through 12 hr. Ewes given LPS had higher ($P < 0.01$) MAX than CONT ewes from 1 hr after treatment through 6 hr. Within ewes given LPS, MAX was lower than VT ($P < 0.02$) during the entire sampling period and lower than RT ($P < 0.03$) from 3 hr through 48 hr after treatment. Within CONT ewes, MAX was lower than RT and VT ($P < 0.01$) during the sampling period. There was no difference ($P > 0.10$) between RT and VT within either the CONT or LPS ewes. Overall, VT and RT were highly correlated ($r = 0.96$, $P < 0.0001$) and MAX was highly correlated with RT ($r = 0.82$, $P < 0.001$) and VT ($r = 0.93$, $P < 0.0001$). In agreement with our previous work, these results suggest that thermography of eye, using maximum eye temperature, may have application as a non-invasive method to measure elevated body temperatures in the ewe.

Key Words: Thermography, Eye, Sheep

968 Effects of plane of nutrition and selenium on colostrum quality and mammary development in ewes. T. J. Swanson*[1], C. J. Hammer[1], J. B. Taylor[2], D. A. Redmer[1], K. A. Vonnahme[1], J. S. Luther[1], T. L. Neville[1], J. J. Reed[1], J. S. Caton[1], and L. P. Reynolds[1], [1]*North Dakota State University*, *Fargo*, [2]*USDA-ARS, U.S. Sheep Experiment Station*, *Dubois, ID*.

To examine the effects of plane of nutrition and selenium supplementation on colostrum quality and mammary development in pregnant ewe lambs, 82 Rambouillet ewe lambs were allotted randomly to one of six treatments in a 3 × 2 factorial design. Groups included dietary levels of Se [adequate Se (ASe, 7.4 µg/kg BW) vs. high Se (HSe, 85 µg/kg BW)], and plane of nutrition [60% (RES), 100% (CON), and 140% (HIGH) of NRC requirements for ewe lambs]. Basal diets were fed once daily in complete pelleted form and HSe ewes received a Se pellet to meet the required Se level. Upon parturition lambs were immediately separated from their dams. Three hours post lambing colostrum was stripped from the udder. Colostrum yield was measured and samples obtained for milk component and IgG analysis. Ewes were slaughtered within 24 h of parturition and mammary tissues collected for RNA, DNA, and protein analysis. Plane of nutrition decreased ($P<0.05$) mammary gland weight in RES (670.1 g) compared to CON (838.9 g) and HIGH (815.3 g). In contrast, Se had no effect on ewe mammary weight. Colostrum weight and volume were lower ($P<0.01$) in RES (343.8 g and 325.9 mL respectively) and HIGH (364.0 g and 364.0 mL respectively) compared to CON (585.7 g and 575.1 mL respectively). Total IgG was lower ($P<0.02$) in RES (32 g/L) and tended ($P<0.06$) to be lower in HIGH (34 g/L) compared with CON (43 g/L). Plane of nutrition decreased ($P<0.02$) butter fat, lactose, and nonfat solids in colostrum of RES and HIGH compared to CON. Milk urea nitrogen increased ($P<0.02$) with increasing plane of nutrition. There was no effect of Se on any colostrum components measured. Total DNA and RNA in mammary tissue was lower ($P<0.03$) in RES (1.52 g and 2.21 g respectively) compared to CON (2.18 g and 3.42 g respectively). Total RNA in RES was also lower ($P<0.01$) compared to HIGH. Results indicate plane of nutrition plays a fundamental role in both colostrum formation and mammary gland development in pregnant ewe lambs.

Key Words: Colostrum, Selenium

969 Evaluating nutritional status of Dorper and Rambouillet ewes in a range sheep production system. T. R. Whitney*, D. F. Waldron, T. D. Willingham, and B. O. Payne, *Texas A&M Agricultural Experiment Station*, *San Angelo*.

Nutritional status of Dorper and Rambouillet ewes, originating from multiple flocks and grazing a common pasture was investigated. Forty-six Dorper and 33 Rambouillet ewes that lambed within the first 45 days of the lambing season (January 12 to February 26) were used. Data were analyzed with a model that included breed and age of ewe as fixed effects, BW at the start of the breeding season as a linear covariate, and flock of origin of the ewe as a random effect. Blood samples were collected from ewes at the start of the breeding season (August 9 and 16), mid-gestation (October 28 and November 9), and late gestation (December 13 and 20). Dorper ewes had greater insulin-like growth factor-1 (IGF-1; $P < 0.05$) concentrations except on August 16, and had greater non-esterified fatty acid concentrations than Rambouillet ewes on August 9 and 16 and November 9. Since IGF-1 has been shown to be directly related to performance and reproduction efficiency, these results suggest that Dorper ewes could possibly have greater production efficiency than Rambouillet ewes on rangelands. In contrast, higher NEFA concentrations suggest that Dorper ewes were at times, catabolizing more fat than Rambouillet ewes. Dorper ewes had greater body condition (BC; $P < 0.05$) than Rambouillet ewes at the beginning of the study. Thus, either Dorpers were more capable of using stored energy reserves (e.g. fat) during periods of poor nutrition, or they have higher NEFA concentrations than Rambouillets due to genetics. Results are not conclusive since serum metabolite and hormone concentrations must be analyzed over longer periods of time and interpreted along with other measures. Data from the second year of this study need to be analyzed to make better inferences.

Key Words: Insulin-like Growth Factor-1, Sheep, Physiology

970 Variation in metabolic parameters in dairy cattle kept in a constant environment. K. L. Ingvartsen*, T. Larsen, P. Berg, and N. C. Friggens, *University of Aarhus, Faculty of Agricultural Sciences*, *Tjele, Denmark*.

The aim of this study was to describe normal changes in selected physiological variables dependent on breed, lactation number and time in lactation in a constant environment and describe phenotypic and genetic variation in physiological variables. The experimental design has been published earlier (Nielsen et al., 2003, LPS 79, 119-133) as has the blood sampling and univariate analysis (Ingvartsen & Friggens, 2005, DAE 29, 294-304). In short, a total of 317 cows (Danish Red (RD), Danish Holstein (DH) and Jersey (DJ)) and 634 lactations (parity 1, 2, ≥3) were included. Blood samples collected weekly from -28 d to 298 d relative to calving, a total of 10809 samples, were analyzed for selected hormones, metabolites, and minerals (only non-esterified fatty acids (NEFA), β-hydroxybutyrate (BHBA) and glucose included here). Mixed models using random regression techniques (LeGendre

polynomials) were set up to analyze the systematic effects comprising combinations of breed, line, feeding, parity and time in lactation using the MIXED procedure in SAS. Variance components were estimated across breeds using a package for multivariate mixed models (DMU-program, Madsen & Jensen, 2000). A significant interaction between breed and parity was observed for NEFA, these were higher concentration ($P<0.05$) in DH compared to DJ for parity 2 and 3. RD had generally lower NEFA compared to DH. While DH and DR showed marked differences in BHBA profiles due to parity DJ did not, causing an interaction ($P<0.05$). Also for glucose an interaction between breed and lactation was found. In general glucose was lowest in DJ, particularly for primiparous cows, and the concentration did not increase as quick after nadir as in DH and DR. For both NEFA, BHBA and glucose the between cow variation was highest in early lactation. The intra-class (intra-cow) correlation during the first 4 weeks declined from 0.71 to 0.46 for NEFA, 0.44 to 0.36 for BHBA and 0.44 to 0.27 for glucose. The large between cow variation and relatively high intra-class correlation indicates that these parameters may be of use to describe animal status.

Key Words: Metabolites, Variation, Dairy Cattle

971 Uncovering adaptive hepatic gene networks due to prepartum plane of dietary energy and physiological state in periparturient Holstein cows. M. Bionaz*, J. K. Drackley, S. L. Rodriguez-Zas, H. M. Dann, N. A. Janovick Guretzky, R. E. Everts, R. Oliveira, H. A. Lewin, and J. J. Loor, *University of Illinois*, *Urbana*.

Gene network assembly from bovine tissue microarray studies could advance our understanding of function and molecular events underlying complex traits (e.g., fatty liver, ketosis). Joint ANOVA using MIXED was conducted on liver microarray data (174 arrays) from 2 of our published studies (Physiol. Genomics 23:217-226, 27:29-41) using a platform with 7,872 bovine cDNA inserts. Liver microarray data were generated from Holstein cows fed control (100% of NRC), ad libitum (ca. 150% of NRC; AA), or restricted (ca. 80% of NRC; RR) energy diets and biopsied at -65, -30, -14, 1, 14, 28, and 49 d relative to parturition. The statistical model included cow as random effect and time, diet, and time × diet as fixed effects. A total of 1,555 genes showed a time × diet interaction ($P < 0.0001$). Ingenuity Pathways Analysis software recognized and mapped 798 genes. A cut-off of ≥1.5-fold change in expression on d -14, 1, 14, 28, and 49 relative to -30 was used. Analysis showed that on d -14, 1, and 14, cell-to-cell signaling (20-28 genes) molecular transport (10-13 genes), and tissue development (16-24 genes) were among the most affected molecular functions in cows fed AA. In cows fed RR gene transcription (12-76 genes), protein synthesis (8-30 genes), and immune response (17-23 genes) were among the most enriched molecular/physiological functions. Fewer genes changed by ≥1.5-fold relative to d -30 in control liver. Several canonical pathways enriched in the data set also were observed, e.g. Integrin and Actin cytoskeleton signaling (AA primarily), protein ubiquitination and complement cascade (RR primarily), and ERK/MAPK and IGF-1 signaling (control primarily). Results confirmed that RR and AA prepartum affected liver genomic adaptations differently. However, one of the most striking observations from this analysis was the marked effect of prepartum dietary energy on expression of genes associated with functions (e.g. transport, gene transcription) supporting tissue remodeling.

Key Words: Microarray, Liver, Genomics

972 Liver fatty acid binding protein (FABP) and acyl-CoA synthase (ACSL) isoform gene expression due to plane of dietary energy prepartum in dairy cows. M. Bionaz*, J. K. Drackley, H. M. Dann, and J. J. Loor, *University of Illinois*, *Urbana*.

Specific isoforms of FABP and ACSL may work in concert to partition fatty acids towards discrete metabolic pathways in liver, particularly after parturition when NEFA influx increases dramatically. The main objective of this study was to examine mRNA expression by qPCR of FABP (1, 3, 4, 5, 6) and ACSL (1, 2, 3, 4, 5, 6) family members in liver from Holstein cows fed control (100% of NRC) or ad libitum (ca. 150% of NRC; AA) energy diets and biopsied at -14, 1, and 14 d relative to parturition. Expression of 14 genes with key functions in fatty acid oxidation (LPIN1, ACOX1, CPT1A, PPARA, PPARGC1A, CYP4A11), lipid synthesis and desaturation (DGAT1, SCD, HMGCR), fatty acid transport (CD36), lipid droplet synthesis (S3-12, LSDP5, ADFP), and RP9 (reference gene) also were analyzed. ANOVA using MIXED was used for statistical analysis. All ACSL isoforms and the 1, 4, and 6 FABP isoforms were affected by day relative to parturition ($P \leq 0.10$). Relative to d -14, ACSL1 increased on d 1 whereas ACSL isoforms 2 through 6 decreased. Similarly, FABP4 and FAPB6 increased on d 1 whereas FABP1 decreased relative to d -14. A significant interaction effect was observed for ACSL3, ACSL4, FABP4, and FABP5. Expression of FABP isoforms was 4 to 11-fold greater with AA vs. control on d 1. Cows fed control had greater overall expression of ACSL3 and FABP3. Among other genes examined, expression of HMGCR and SCD in cows fed control vs. AA experienced a marked decrease by d 1 and then increased by d 14 resulting in an interaction effect. The opposite response was observed for CD36 expression. Expression of PPARA on d 14 was higher in cows fed control vs. AA. ADFP and PPARGC1A expression increased over time, reaching peak values on d 1. Results indicate that prepartum plane of dietary energy affects expression of FABP and ACSL family members to different extents primarily on d -14 and 1. The fate of exogenous fatty acids (e.g., fatty acid oxidation vs. esterification) in the liver could be dictated at least in part by the expression pattern of specific ACSL and FABP isoforms.

Key Words: Liver, Gene Expression, Dairy Cows

973 The use of nicotinic acid as antilipolytic agent to induce sustained low plasma NEFA concentrations in feed restricted Holstein cows. J. A. A. Pires* and R. R. Grummer, *University of Wisconsin*, *Madison*.

The objectives were to determine the effects of nicotinic acid (NA) on blood metabolites (experiment 1) and whether successive doses of NA can induce sustained reductions of plasma nonesterified fatty acid (NEFA; experiment 2) in feed restricted non-lactating Holstein cows. Experiment 1 was a 4 × 4 Latin Square with 1 wk periods. Each period consisted of 2.5 d of feed restriction to increase plasma NEFA and 4.5 d of ad libitum feeding. Treatments were abomasal administration of 0, 6, 30 or 60 mg/kg BW of NA, given as a single bolus 48 h after initiation of feed restriction. Plasma NEFA concentration decreased (treatment and treatment × time: $P < 0.001$) from 546 uEq/L to 208 uEq/L at 1 h after the infusion of 6 mg NA/kg BW, and to less than 100 uEq/L at 3 h after the abomasal infusion of the two highest doses of NA. A rebound occurred after the initial decrease of plasma NEFA concentration during which NEFA increased transiently above 1,200 uEq/L. The rebound lasted up to 9 h for 30 mg NA/kg BW dose, and up to 6 h for 6 mg NA/kg BW dose. Experiment 2 was a randomized

complete block design with 3 treatments and 6 cows. Starting at 48 h of feed restriction, cows received nine hourly abomasal infusions of 0, 6 or 10 mg/kg BW of NA. Plasma NEFA concentrations was 553 uEq/L immediately before the initiation of treatments, and decreased to less than 100 uEq/L during infusions of 6 or 10 mg NA/h per kg BW (treatment × time: $P < 0.001$). Data suggest that the maximal antilipolytic response was achieved with the lowest dose of NA. NEFA concentrations rebounded to over 2,100 uEq/L 4 h after termination of NA infusions. The profile of insulin and glucose concentration suggests a state of insulin resistance during NEFA rebound in both experiments. This model for altering plasma NEFA concentration by abomasal infusions of NA can be used to study the metabolic ramifications of elevated vs. reduced NEFA concentrations. The data demonstrate potential benefits and pitfalls of using NA to regulate plasma NEFA and prevent lipid related metabolic disorders.

Key Words: Nicotinic Acid, NEFA, Bovine

974 Reduction of plasma NEFA concentration by nicotinic acid enhances the response to insulin in feed restricted Holstein cows. J. A. A. Pires*, J. B. Pescara, and R. R. Grummer, *University of Wisconsin*, *Madison*.

The objective was to study the effects of lowering plasma nonesterified fatty acid (NEFA) concentration, using supraphysiologic doses of nicotinic acid (NA) as an antilipolytic agent, on the responses to intravenous glucose tolerance test (IVGTT) in feed restricted Holstein cows. Six non-lactating, non-gestating, ruminally cannulated Holstein cows were blocked by body condition score, and randomly assigned to a sequence of two treatments in a cross-over design. Cows were offered legume/grass hay ad libitum, supplemented with minerals and vitamins and allowed free access to water and trace mineralized salt block. Mobilization of body reserves was stimulated by withdrawing forage for 48 h before initiation of treatments. Treatments consisted of eleven hourly abomasal infusions of water (control) or NA (6 mg/h per kg BW). Intravenous glucose tolerance test (0.25g glucose/kg BW) was performed 8 h after initiation of treatments and was followed by 3 h of blood sampling. Infusions of NA decreased ($P < 0.001$) plasma NEFA concentration from 545 µEq/L to around 100 µEq/L within 2 h after initiation of treatments and significant differences were maintained throughout infusions. The reduction of plasma NEFA concentration led to significantly greater glucose clearance rate (1.9 vs. 1.2 %/min, $P = 0.002$) and to decreased glucose half life (37 vs. 58 min; $P < 0.001$), time to reach basal concentration (81 vs. 114 min; $P < 0.001$) and glucose response area under the curve during 180 min of sampling (AUC180; 6942 vs. 10085 (µIU/mL)*180 min; $P < 0.001$). Enhanced glucose clearance was achieved despite lower ($P = 0.05$) insulin concentration (70.0 vs. 97.9 ± 13.4 µIU/mL) and a tendency ($P = 0.11$) for smaller AUC180 (7646 vs. 12104 ± 2587 (µIU/mL)*180 min) when plasma NEFA was reduced by NA, reflecting increased response to endogenous insulin. Based on literature, we do not expect NA to have altered glucose metabolism directly. Therefore, this experiment demonstrates a cause-effect relationship between elevated NEFA and insulin resistance in Holstein cows.

Key Words: NEFA, Insulin Resistance, Nicotinic Acid

975 Effect of short-term feeding of a plant botanical during late-gestation on temperature and physiological responses of piglets challenged with LPS. J. L. Salak-Johnson*[1], J. M. Suchomel[1], S. R. Niekamp[1], S. Block[2], and R. Balsbaugh[3], [1]*University of Illinois at Urbana-Champaign*, *Urbana*, [2]*ADM Animal Nutrition Research*, *Decatur, IN*, [3]*ADM Alliance Nutrition, Inc.*, *Quincy, IL*.

Crossbred sows were fed a control (n = 10) or treated (n = 15 ; control + plant botanical) diet for 14 d prior to farrowing to determine the impact of feeding a gestation diet supplemented with a plant botanical on piglet temperature and physiological responses to lipopolysaccharide (LPS). At birth, piglets were weighed and rectal temperatures were recorded. Eight piglets/litter were randomly chosen to receive a saline (n = 90) or LPS (n = 90); 25 µg/kg of BW) challenge at 24-h or 72-h of age with 2 pigs assigned per challenge category. Rectal temperature was recorded frequently and blood samples were collected 2 h post-challenge. Data were analyzed with the MIXED procedure of SAS. Diet×LPS×age interaction was observed for piglet rectal temperature. Piglets from sows fed treated diet had greater ($P < 0.05$) temperature response to LPS than did pigs from control sows at 24 h. Piglets farrowed by treated sows had greater ($P < 0.05$) temperature at 72 h than did 24 h piglets regardless of challenge. Piglets farrowed by control sows and challenged at 72 h with LPS had greater ($P < 0.05$) temperature than did piglets from sows fed treated diet. Diet or LPS had an affect on interleukin (IL)-10 and -12, but not IL-6. Piglets farrowed by treated sows had greater ($P < 0.05$) IL-10 than did control diet×LPS piglets. Plasma IL-12 was less ($P < 0.05$) in piglets from sows fed treated diet than control and IL-10 was greater ($P < 0.001$) in LPS pigs than in saline pigs. Cortisol was greater in LPS piglets than saline regardless of diet or age ($P < 0.001$). But, 24 h pigs had greater ($P < 0.05$) cortisol in response to LPS than did 72 h pigs. Piglets from sows on control diet had greater ($P = 0.14$) cortisol response to LPS than did piglets from sows fed treated diet. These data indicate that feeding sows a gestation diet supplemented with plant botanical has modulatory affects on the physiological responses of piglets, but no affect on piglet thermoregulatory processes.

Key Words: Piglet, Immune, Plant Botanical

976 Effects of multiple concurrent stressors on rectal temperature, blood acid-base status, and loin muscle glycolytic potential in market weight pigs. M. J. Ritter*[1], M. Ellis[2], D. B. Anderson[3], S. E. Curtis[2], K. K. Keffaber[1], J. Killefer[2], F. K. McKeith[2], C. M. Murphy[2], and B. A. Peterson[2], [1]*Elanco Animal Health*, *Greenfield, IN*, [2]*University of Illinois*, *Urbana*, [3]*Colorado State University*, *Fort Collins*.

Sixty four market weight (130.0±0.65 kg) barrows (n=16) and gilts (n=48) were used in a split-plot design with a 2×2×2 factorial arrangement of treatments: 1) handling intensity (gentle vs. aggressive); 2) transport floor space (0.39 vs. 0.49 m^2/pig); and 3) distance moved during handling (25 vs. 125 m) to determine the effects of multiple concurrent stressors on the stress responses of pigs. Pigs were moved ~50 m through a course with 0 (gentle) or 8 (aggressive) shocks from an electric goad. Next, pigs were loaded onto a trailer and transported for ~1 h at floor spaces of 0.39 or 0.49 m^2/pig. After transport, pigs were unloaded and moved 25 or 125 m through a course using livestock paddles. Rectal temperature was measured and blood samples were collected 2 h before handling procedures and immediately after

distance moved treatments. Longissimus glycolytic potential was also measured after the distance moved treatments on a subset of 32 pigs. Data were analyzed using PROC MIXED and PROC REG of SAS. Handling intensity × distance moved interactions existed (P<0.05) for several blood acid-base measurements. In general, there was no effect of distance moved on these traits when pigs were previously handled gently. However, when pigs were previously handled aggressively, pigs moved 125 compared to 25 m had higher (P<0.05) blood lactate and lower (P<0.05) blood pH, bicarbonate, and base-excess. Pigs transported at 0.39 compared to 0.49 m^2/pig had larger (P<0.01) increases in creatine kinase values, however, transport floor space did not affect any other measurements. Data were also analyzed by the number of stressors (aggressive handling, restricted transport floor space, and moved 125 m during handling) experienced by each pig (0, 1, 2, or 3). As stressor number increased, there was a linear increase (P≤0.01) in rectal temperature, blood lactate, and longissimus lactate and a linear decrease (P<0.01) in blood pH, bicarbonate, and base-excess. These data suggest that the stressors evaluated had additive effects on rectal temperature, longissimus lactate values, and blood acid-base balance.

Key Words: Pig, Handling, Pre-slaughter Stress

977 Neonatal Fc receptor mRNA expression in fetal pigs and in gastrointestinal tissues from pigs fed diets of varying form with or without irradiated and non-irradiated spay-dried animal plasma. C. N. Groesbeck*[1], T. E. Burkey[2], J. E. Minton[1], S. S. Dritz[1], R. D. Goodband[1], M. D Tokach[1], J. M. DeRouchey[1], and J. L. Nelssen[1], [1]*Kansas State University*, *Manhattan*, [2]*University of Nebraska*, *Lincoln*.

The neonatal Fc receptor (FcRn) participates in intracellular trafficking of IgG and the maintenance of circulating IgG. Also, the relationship between the FcRn and IgG may augment host defense immunosurveillance. The current studies evaluated FcRn mRNA from intestinal tissues in fetal pigs and weaned pigs fed meal or pelleted diets with or without irradiated or non-irradiated spray-dried animal plasma. In Exp. 1, fetal pigs were obtained at d 55 and d 70 of gestation (n = 5 fetuses/gestational age) and total RNA was isolated from intestinal tissues for quantitative real-time PCR (qPCR) to determine mRNA for FcRn. FcRn transcripts were observed in all samples, and greater levels of FcRn mRNA were observed in d 55 fetuses compared to d 70 fetuses (P < 0.02). In Exp. 2, weaned pigs were used in an 11-d growth assay to determine the effects of feeding meal and pelleted diets with irradiated or non-irradiated spray-dried animal plasma (AP 920) on FcRn expression in intestinal tissues. Pigs were blocked by weight and randomly allotted in a 2 × 2 factorial to one of four dietary treatments. Main effects were diet form (meal or pellet) and either irradiated or non-irradiated spray-dried animal plasma. Jejunal, ileal, and cecal tissues were collected from 24 pigs at the conclusion of the growth assay. Total RNA was isolated to quantify relative mRNA expression of FcRn. FcRn transcripts were again observed in all samples. FcRn mRNA was more abundant in pigs fed diets containing non-irradiated plasma compared with pigs fed the irradiated plasma (P < 0.02, 1.01 vs 0.57). FcRn mRNA was also more abundant in the pigs fed meal diets than pelleted diets (P < 0.05, 0.98 vs 0.59). The results suggest FcRn varies with gestational age in pigs and with factors affecting dietary bacterial load.

Key Words: FcRn Receptor, Irradiation, Pig

Poultry-Breeding and Hatchery Symposium: Semen Evaulation and Fertility Determination in Poultry

978 Using sperm penetration values to evaluate broiler breeder performance and reproductive efficiency. R. K. Bramwell*, *University of Arkansas*, *Fayetteville*.

The sperm penetration assay is a technique developed to quantitatively assess sperm-egg binding and penetration of the perivitelline layer (PL) enveloping the ovum of the avian egg. The process of sperm-egg binding and penetration represents one of the final steps in fertilization sperm must accomplish in order access the female pronucleus for syngamy. Sperm penetration (SP) values have proven to be beneficial for both research and industry applications as these values are based on a sliding scale as opposed to a binary scale for fertility values. As a research tool, male and or female contribution to infertility can be evaluated with much greater accuracy than using fertility values alone. As an industry tool, SP values are used to evaluate broiler breeder flocks experiencing poor hatchability. From identified broiler breeder flocks, each egg from a 50-egg sample is subjected to the SP assay. Holes in the PL overlying the germinal disc caused by sperm-egg binding and the subsequent acrosome reaction are counted and the values recorded in one of five groups (0-10, 11-30, 31-60, 61-100, over 100 holes). Data is expressed as a percentage of the egg samples that produced values in one of the five groups previously reported. For each age group of broiler breeder flocks, an ideal standard has been determined and each flock can be compared to that standard to determine their reproductive efficiency. From this data, the cause of poor performance can be determined and recommendations made improve breeder flock performance.

Key Words: Sperm Penetration, Sperm-Egg Binding, Fertility

979 Advances in sperm cell biology stemming from the analysis of sperm mobility. D. Froman*, *Oregon State University*, *Corvallis*.

Sperm mobility is a quantitative trait discovered in the mid-1990s. The term *sperm mobility* denotes the net movement of a sperm cell population against resistance at body temperature. The trait was discovered after development of a test based upon sperm penetration of 6% (wt/vol) Accudenz from an overlaid sperm suspension. This test was proven to be simple, objective, and suitable for semen analysis in the field as well as the laboratory. When applied to populations of males, extreme variation was observed among males. Sperm mobility phenotype was independent of age. The relationship between in vitro sperm mobility and male fecundity warranted a systematic analysis. Sperm mobility was proven to be a primary determinant of fertility based upon competitive and non-competitive fertilization. In fact, fertility was a *function* of sperm mobility phenotype. Heritability (h^2)

was estimated to be 0.30 using a random bred population. Thereafter, distinct lines were produced by genetic selection. Phenotypic variation evaluated with computer-assisted sperm motion analysis, which described motile properties of individual sperm within populations. Motile concentration and straight line velocity (VSL) were used to predict sperm mobility. Specifically, phenotype was a function of the area within the upper tail of a male's VSL distribution. Consequently, the predictive power of the sperm mobility assay depends on a context in which the *consequences* of variation in VSL become manifest in time. The shape of VSL distributions was explicable in terms of mitochondrial function. In this regard, mobile sperm were rendered immobile by a reagent used to induce the mitochondrial permeability transition pore. Consequently phenotypic variation may be related to Ca^{2+} overloading while sperm pass through excurrent ducts of the testis. As such, a sperm mobility measurement may reflect the proportion of disabled sperm within an ejaculate. Three unexpected experimental outcomes included: (1) a model explaining in vivo sperm storage, (2) the relationship between mitochondrial Ca^{2+} cycling and sperm motility, and (3) a new paradigm for artificial semen storage.

Key Words: Sperm Mobility, Sperm Motility, Semen Storage

980 Using the Sperm Quality Analyzer Vt for dosimetry of turkey semen in commercial turkey operations; the potential impact on fertility, and the economic implications of better utilization of sires with superior growth potential. K. K. Krueger*, *Diamond K Research*, *Marshville, NC*.

The Sperm Quality Analyzer Vt (SQA Vt) estimates total (TSC) and motile sperm cell (MSC) concentration in either neat or diluted turkey semen. The device is simple to use and results are returned within 3 minutes. No special calibration, operator training, or sensitive reagents are required. Bench trials have confirmed SQA Vt accuracy and repeatability matches or exceeds other methodologies (i.e., hemocytometer, conventional photo spectroscopy, subjective microscopy). Several field trials and ongoing use in properly managed and supervised commercial turkey operations have shown that when dosimetry is based on motile sperm cell number that ~150 million motile sperm per insemination had no adverse effect on fertility. When insemination doses were prepared on motile sperm cell number, fertility was found to be more stable and often improved during the latter weeks of egg production. Dosimetry based on motile sperm cell numbers has been shown to have a positive impact on fertility, but more importantly it allows sires with superior growth characteristics to be used more efficiently and effectively. Unlike the swine and cattle industries where better superior sire utilization is a primary concern, the commercial turkey industry has failed to recognize the potential impact this concept can have on profitability. Identifying males with superior growth and carcass characteristics, managing them for optimum motile sperm cell production, maximum harvest, and motile sperm cell based dosimetry can have a significant impact on genetic progress and economics in the turkey industry.

Key Words: Sperm, Motility, Fertility

981 Using egg breakout to estimate flock fertility. J. L. Wilson*, *University of Georgia*, *Athens*.

Egg breakout is an excellent tool to estimate flock fertility. This information is used in determining the number of eggs to incubate to meet broiler placements. In addition, egg breakout is a powerful diagnostic tool when flocks are not hatching as expected. It is important to candle eggs between 10-14 days of incubation and open the eggs to determine percentage fertility and early dead embryos. While the end results of low fertility or high numbers of early dead embryos are both low hatchability the causes are distinctly different. Valuable time can be gained in quickly identifying fertility issues and making managerial changes such as spiking the flock to increase fertility. High early embryonic mortality is usually related to egg handling, flock health or chemical exposure. During the candling process other important information can be gathered like the number of eggs in the incubator flat upside down and number of eggs with hairline cracks. Gathering and using egg breakout data to correct low fertility, high embryo mortality, upside down egg placement or loss due to high cracked egg numbers is critical in maximizing chick production.

Key Words: Egg Breakout, Fertility, Candling

Ruminant Nutrition: Nitrogen Digestion/Metabolism

982 Development and establishment of an enzymatic in vitro procedure for estimating intestinal protein digestibility of feedstuffs for ruminants. R. Irshaid[1,2] and K.-H. Suedekum*[2], [1]*University of Kiel*, *Kiel, Germany*, [2]*University of Bonn*, *Bonn, Germany*.

This study utilized forty-nine feed samples to develop and establish a completely laboratory-based, enzymatic in vitro procedure (EIVP) for estimating the intestinal protein digestibility (IPD) of rumen-undegradable protein (RUP) of forages and concentrates. Feed samples encompassed forages with varying crude protein (CP) contents, unprotected or rumen-protected protein supplements and cereal grains representing energy-rich feeds of low to medium CP concentration. The EIVP involved the subsequent digestion of samples with a protease from *Streptomyces griseus*, pepsin-HCl, and pancreatin. The concentration of the *S. griseus* enzyme was related to the true protein content of the feed sample. Briefly, the EIVP started with determination of true protein. Feeds were incubated for 18 h in a buffer solution at a constant ratio (41 U/g) of *S. griseus* protease activity to feed true protein. The dried residues were incubated in pepsin-HCl solution for 1 h and residues from this step were incubated with pancreatin solution for 24 h. Samples had previously been used for IPD estimates using a three-step in situ-in vitro procedure (ISIVP) and mobile-bag technique (MBT). The relationships between IPD values estimated by EIVP and ISIVP or MBT were best described by linear regression equations: IPD_{MBT} (g/kg true protein) = 1.221 IPD_{EIVP} (g/kg true protein) - 165.95 ($n = 38$, $r^2 = 0.666$, $P < 0.0001$) and IPD_{ISIVP} (g/kg true protein) = 1.053 IPD_{EIVP} (g/kg true protein) - 28.14 ($n = 49$, $r^2 = 0.985$, $P < 0.0001$). Results from the EIVP closely resembled those obtained with the ISIVP and thus, the completely laboratory-based, standardized EIVP can replace the more invasive ISIVP for estimating IPD of a wide range of feedstuffs for ruminants.

Key Words: Protein, Digestibility, Small Intestine

983 Evaluation of lysine digestibility in rumen undegraded protein using the precision-fed rooster assay and two *in vitro* methods. S. E. Boucher*[1], C. Pedersen[2], H. H. Stein[3], C. M. Parsons[3], and C. G. Schwab[1], [1]*University of New Hampshire*, *Durham*, [2]*Danisco Animal Nutrition*, *Marlborough, UK*, [3]*University of Illinois*, *Urbana*.

Sixteen feed samples were obtained from the Feed Analysis Consortium, Inc. to evaluate furosine and homoarginine (HA) methods for determining the availability of Lys in rumen undegraded protein (RUP-Lys). Furosine is a secondary product of the initial stages of the Maillard reaction, and HA is formed by the reaction of reactive Lys with O-methylisourea (guanidination reaction). Three samples of soybean meal (SBM), 3 samples of SoyPlus®, 5 samples of dried distillers grains with solubles (DDGS), and 5 samples of fishmeal (FM) were used. Samples were incubated for 16 h *in situ* in the rumen of 4 lactating Holstein cows, averaging (mean ± SD) 48 ± 4 days in milk, fed a 55% forage, 45% concentrate diet. Residues were collected and pooled by feed sample, and portions were crop-intubated to cecectomized roosters. Four birds per sample were intubated with the residue, and endogenous AA excretion was estimated from fasted roosters. Total excreta was collected for 48 h post-intubation and analyzed for Lys content. True digestibility (TD) of RUP-Lys was calculated. In the furosine method, all residues were analyzed for furosine and Lys content; however, only 9 of the 16 samples contained furosine. Percent blocked Lys was calculated. In the HA method all residues were guanidinated for 72 h and analyzed for Lys and HA content. The percent Lys converted to HA was calculated. The results of the experiment showed that percent furosine (n=9), blocked Lys (n=9), and Lys converted to HA (n=16) were correlated to TD of RUP-Lys (R^2 = 0.86 0.94, and 0.90, respectively). In conclusion, it appears that measurements of furosine or HA in rumen digesta residues of SBM, SoyPlus®, DDGS, and FM can be used to predict RUP-Lys digestibility.

Key Words: Lysine Digestibility, Rumen Undegraded Protein, Cecectomized Roosters

984 Amino acid digestibility in rumen undegraded protein estimated in cecectomized roosters and the immobilized digestive enzyme assay (IDEA™). S. E. Boucher*[1], M. Vázquez-Añán[2], J. Wu[2], C. M. Parsons[3], and C. G. Schwab[1], [1]*University of New Hampshire*, *Durham*, [2]*Novus International*, *St. Louis, MO*, [3]*University of Illinois*, *Urbana*.

Sixteen feed samples were obtained from the Feed Analysis Consortium, Inc. to evaluate the immobilized digestive enzyme assay (IDEA™; Novus International, Inc.) as an *in vitro* method to estimate the digestibility of amino acids (AA) in rumen undegraded protein (RUP-AA). Three soybean meal (SBM), 3 SoyPlus®, 5 dried distillers grains with solubles (DDGS), and 5 fishmeal (FM) samples were used. Each sample was incubated for 16 h *in situ* in the rumen of 4 lactating Holstein cows averaging (mean ± SD) 48 ± 4 days in milk, fed a 55% forage, 45% concentrate diet. Residues were collected and pooled by feed sample, and portions analyzed for AA content, crop-intubated to cecectomized roosters, and analyzed via IDEA™. Four birds per sample were used, and endogenous AA excretion was estimated from fasted roosters. Total excreta was collected for 48 h post-intubation and analyzed for AA content. True digestibility (TD) of RUP-AA was calculated. The IDEA™ consisted of 4 steps; sample preparation, dissolution, digestion, and *o*-phthaldialdehyde (OPA) analysis. An IDEA™ value was calculated for each sample based on absorption of the product after the OPA reaction. The IDEA™ values were correlated to TD of RUP-AA measured in the roosters. The IDEA™ values were good predictors of the digestibility of RUP-AA in SBM and SoyPlus® (R^2 = 0.91 and 0.83 for Lys and Met, respectively) and DDGS (R^2 = 0.95 and 0.95 for Lys and Met, respectively). However, the IDEA™ values were not as good predictors of RUP-AA digestibility in FM (R^2 = 0.53 and 0.46 for Lys and Met, respectively) which may be due to a lack of variability in digestibility of RUP-AA among the FM samples. In conclusion, IDEA™ may be a good approach for predicting the digestibility of RUP-AA in SBM and DDGS, and further evaluation of IDEA™ for predicting digestibility of RUP-AA in FM is warranted.

Key Words: Amino Acid Digestibility, Immobilized Digestive Enzyme Assay™, Rumen Undegraded Protein

985 Influence of level of intake upon rumen degradability of protein sources. I. Schadt*[1], G. Azzaro[1], R. Petriglieri[1], P. J. Van Soest[2], K.-H. Südekum[3], and G. Licitra[1,4], [1]*CoRFiLaC, Regione Siciliana*, *Ragusa, Italy*, [2]*Cornell University*, *Ithaca, NY*, [3]*University of Bonn*, *Bonn, Germany*, [4]*D.A.C.P.A. University of Catania*, *Catania, Italy*.

Increasing intake pushes rumen turnover, passage and protein escape. The objective of this study was to investigate the effect of turnover on rates of protein degradation. Five protein sources: herring meal, soy flakes, soybean meal, sunflower and brewers grains were incubated in situ for 4, 8, 12, 24, 36, 48 and 72 hours and residual nitrogen measured with six cows, two dry, two midlactation and two at high level of intake and milk production. The TMR′s fed to respective cows were also incubated in situ. The level of DMI (level 1, 2, 3, respectively, range: 9,9 to 25,4 kg DM/d) significantly reduced rates of rumen degradability rates for all protein sources, varying from 12-50% from the lowest to the highest intake, depending on the protein source. Rumen escape protein was calculated using estimated Turnover time (T_{DM}) according to Cannas (PhD thesis, Cornell University, 2000). Kp= $1/T_{DM}$ where T_{DM} = 19.89 - 12.82 * LN (dietary Neutral Detergent Solubles intake as % of body weight). Protein degradabilities were also measured with S. griseus protease at the respective times. Average time required for the S. griseus (1 U/ml) to achieve the extents observed in the in situ bags at predicted T_{DM} were 47h at level 1, 11h at level 2, and 5h at level 3. Ratios of these times with T_{DM} estimate rumen enzymatic activities: 1,9U/ml at level 1, 0,9U/ml at level 2 and 0,5U/ml for level 3. Regression of enzyme time on T_{DM} was y = 2.84 - 23.4x, R^2=0.94, n 6. This is evidence that the differences in the respective digestion of the protein sources with intake are due to varying proteolytic activity in the rumen.

Key Words: Rumen Protein Degradability

986 Balancing diets for rumen microbial protein requirements: 1) effects on animal performance under a deficient rumen available protein scenario. P. J. Guiroy*, D. H. Theuninck, C. B. Calk, and J. N. Pike, *Cargill Inc*, *Minnetonka, MN*.

The objective was to evaluate feedlot performance in diets that provided the same percentage of rumen fermentable carbohydrates but differing in the supply of rumen available protein (**RAP**, sum of degradable intake CP and recycled nitrogen). Diets were formulated

with the Cargill MAX™ system, which utilizes a model to estimate microbial CP (**MCP**) based on type and amount of dietary carbohydrates fermented in the rumen. The trial was conducted with 1806 steers with 3 treatments and 6 pen replications per treatment for 166 d. All diets were isocaloric, and isonitrogenous at 13.3% CP. Diets contained the same inclusion of flaked corn, alfalfa hay, corn silage, fat, and supplement. Treatment supplements contained different sources of protein to meet diet objectives: **Low RAP** diet (RAP deficient by 10% compared to MCP with NPN at 2.50%), **Balanced RAP** diet (compared to MCP with NPN at 3.25%), and **Balanced RAP-High NPN** diet (compared to MCP with NPN at 3.60%). Balanced treatments improved ADG and feed to gain ratio in comparison to Low RAP. Only the Balanced RAP diet resulted in heavier HCW and larger LM in comparison to the Low RAP diet, indicating an advantage in limiting concentration of NPN. DMI was higher during the first 60 d (P< 0.01) when diets were balanced for RAP with a tendency for DMI to be higher for the entire feeding period (P=0.11). Results indicated that meeting MCP requirements with RAP improved DMI and performance. We hypothesize that improved DMI may be due to increasing MCP yield, which results in improved rumen health conditions.

Table 1.

Item	Treatments[1] Low RAP	Balanced RAP	Balanced RAP–High NPN	SEM	P–value
Initial BW, kg	342	343	343	1.54	0.71
Final BW, kg	606[b]	617[a]	613[ab]	2.50	0.02
ADG, kg	1.59[b]	1.65[a]	1.63[a]	0.01	0.01
Daily DMI, kg	9.30	9.52	9.36	0.07	0.11
Feed to Gain ratio	5.85[b]	5.77[a]	5.75[a]	0.019	0.01
HCW, kg	386[b]	394[a]	390[ab]	1.59	0.02
Fat thickness, cm	1.50[b]	1.60[a]	1.58[a]	0.015	<0.01
LM, sq cm	97.4[b]	99.7[a]	98.1[b]	0.45	0.02

[1]Diets were isocaloric (at 1.576 Mcal/kg NEg) and isonitrogenous (at 13.3% CP). [ab]Means differ (P<0.05).

Key Words: Beef, Feedlot, Degradable Intake Protein

987 Balancing diets for rumen microbial protein requirements: 2) effects on animal performance under an excess rumen available protein scenario. J. N. Pike*, P. J. Guiroy, D. H. Theuninck, and C. B. Calk, *Cargill Inc*, *Minnetonka, MN*.

A trial was conducted to evaluate the effect of rumen available protein (**RAP**) relative to microbial CP (**MCP**). The Cargill MAX™ system was used to formulate diets. RAP is the sum of degradable intake protein (**DIP**) and recycled nitrogen while MCP potential is estimated from type and amount of dietary carbohydrate fermented in the rumen. The trial was a 2 x 3 factorial (2 management systems and 3 protein formulations) using mixed breed steers (n=2400, 4 replications). There were no important interactions and only effects of protein formulation will be discussed. Treatments were: **Control**, (13.8% CP, 1.6% NPN, RAP in excess of MCP by 11%); **Balanced** (12.8% CP, .77% NPN, RAP equal MCP), **Hi-Soluble DIP** (13.8% CP, 1.9% NPN, RAP in excess of MCP by 13%). Rations contained 33% steam-flaked corn, 21.5% high-moisture corn, 24% Sweet Bran, 9.5% corn silage, 4.6% tallow and 7.4 % supplement designed to provide desired levels of CP, DIP and NPN. There was a difference in feed conversion (P<0.10) among treatments and a trend for improved ADG for the Balanced diet. There were no differences among treatment groups in HCW or quality grade. The Balanced treatment resulted in lower fat thickness and larger LM than excess RAP diets. Formulating rations to balance RAP with MCP, with no minimum CP, had no negative effects on performance compared with formulating to more typical feedlot crude protein levels. In this trial, balancing RAP with MCP lowered total CP, resulting in reduced feed cost of US$2.81 and US$1.40 per head compared to the Control and Hi-Soluble DIP, respectively.

Table 1.

Item	Treatments[1] Control	Balanced	Hi–Soluble DIP	SEM	P–value
Initial BW, kg[2]	346	343	345	0.94	0.06
Final BW, kg	611	610	610	2.22	0.85
ADG, kg	1.54	1.56	1.51	0.02	0.16
Daily DMI, kg	8.85	8.82	8.84	0.07	0.96
Feed to Gain ratio	5.76[cd]	5.66[c]	5.85[d]	0.06	0.10
HCW, kg	388	387	386	1.24	0.54
Fat thickness, cm	1.35[b]	1.27[a]	1.37[b]	0.02	0.02
LM, sq cm	86.5[b]	91.1[a]	89.5[b]	0.40	0.04

[1]All diets were isocaloric (at 1.62 Mcal/kg NEg). [2]Initial BW did not affect results. [a, b]Means differ (P<0.05). [c, d]Means differ (P<0.10)

Key Words: Beef, Feedlot, Degradable Intake Protein

988 Effect of level of metabolizable protein on milk production and nitrogen utilization in lactating dairy cows. C. Wang*[1], J. X. Liu[1], Z. P. Yuan[1], Y. M. Wu[1], S. W. Zhai[1], and H. W. Ye[2], [1]*Institute of Dairy Sciences, Ministry of Education Key Laboratory of Molecular Animal Nutrition, Zhejiang University*, *Hangzhou 310029, China*, [2]*Hangzhou Zhengxing Animal Industry Company*, *Hangzhou 311301, China*.

The objective of this study was to investigate the effects of levels of metabolizable protein (MP) on milk production and nitrogen utilization in Chinese Holstein dairy cows. Forty multiparous dairy cows (body weigh (BW) =590 kg; days in milk=135; average milk yield=30.2 kg/d) were assigned to treatments randomly within groups based on DIM and milk production. Animals were offered diets with different levels of MP: 8.3 (Diet A), 8.9 (Diet B), 9.7 (Diet C), and 10.4 (Diet D) % of DM. The MP level in Diet A was designed to meet the requirement according to current CNSAPH, while that in Diet D was based on NRC-2001 model. The experiment lasted for seven weeks. Milk yield and milk compositions (fat, protein, and lactose) were recorded, and urea nitrogen concentration in serum, urine, and milk were measured during the experiment. Milk yield and milk protein percentage increased as the MP increased up to 9.7 % of DM, and then leveled off. Concentrations of nitrogen in urine, serum, and milk increased lineally as the MP amount was increased, indicating decreased efficiency of N utilization. Milk lactose percentage and total solid percentage showed no significant differences among four diets. It is concluded that the optimal dietary MP level was at 9.6 % of DM for Chinese Holstein dairy cows producing 30 kg milk per day.

Key Words: Metabolizable Protein, Milk Production, Lactating Cows

989 Nutrient demand affects nitrogen utilization responses to diets containing alfalfa or orchardgrass. J. A. Voelker Linton* and M. S. Allen, *Michigan State University*, *East Lansing*.

Effects of feed intake on relative responses of N intake, digestion, and utilization to alfalfa silage versus orchardgrass silage were evaluated. Eight ruminally and duodenally cannulated Holstein cows were utilized in a crossover design experiment with a 14-d preliminary period and two 15-d treatment periods. Cows were 139 ± 83 (mean ± SD) DIM at the beginning of the preliminary period. During the preliminary period, milk yield ranged from 24.5 to 46.0 kg/d and preliminary voluntary DMI (pVDMI) ranged from 11.4 to 21.0 kg/d. Treatments were a diet with alfalfa silage as the sole forage (AL) and a diet with orchardgrass silage as the sole forage (OG). Alfalfa silage contained 20.5% CP (DM basis) and orchardgrass silage contained 20.4% CP; AL contained 18.3% CP and 5.6% estimated RUP, and OG contained 18.8% CP and 6.3% estimated RUP. Alfalfa silage contained 43% NDF (DM basis) and orchardgrass silage contained 48% NDF; both diets contained 23% forage NDF. Mean N intake was similar between treatments ($P = 0.95$), ruminal N digestibility was greater ($P = 0.03$) for AL than for OG, and whole-tract N digestibility did not differ between treatments ($P = 0.50$). The ability of linear and quadratic factors of pVDMI to predict the difference in responses of individual cows to treatments ($Y_{AL} - Y_{OG}$) was tested by analysis of variance, with treatment sequence as a covariate. With increasing pVDMI, intake and duodenal flow of N increased more for AL than for OG (N intake: $P = 0.01$; duodenal N flow: $P = 0.01$) because of increasingly greater DMI for AL compared to OG as pVDMI increased ($P < 0.01$). However, as pVDMI increased, whole-tract N digestibility tended to decrease for AL relative to OG ($P = 0.07$). When feeding less-filling diets to high-producing cows, reducing dietary N concentration could increase the efficiency of N utilization and reduce the extent to which greater DMI leads to greater N excretion.

Key Words: Grass, Legume, Nitrogen Utilization

990 A comparative review of the flow of nitrogen fractions at the omasal canal and duodenum of dairy cows. I. R. Ipharraguerre*[1], S. M. Reynal[2], P. Huhtanen[3], J. H. Clark[4], G. A. Broderick[2], and S. Ahvenjärvi[5], [1]*Lucta S.A.*, *Barcelona, Spain*, [2]*US Dairy Forage Research Center*, *Madison*, [3]*Cornell University*, *Ithaca*, [4]*University of Illinois*, *Urbana*, [5]*MTT Agrifood Research Finland*, *Jokioinen*.

The objective of this paper was to review and compare published data for the flow of N fractions to the omasal canal and duodenum of lactating dairy cows. Two data sets were created; one with data from 14 studies in which digesta was sampled from the omasal canal (57 means) and the other with data from 67 studies in which digesta was taken from the duodenum (264 means). Mean intakes of DM (DMI 19.7±3.4 kg/d) and N (NI 537±117 g/d) were similar between data sets. Flows (g/d) of nonammonia N (NAN), microbial N (MN), and NAN-non-MN (NANMN), and the ratio NAN/DMI averaged, respectively, 516±128, 342±100, 173±48, and 24.7±3.2 at the omasum; and 508±113, 271±84, 236±87, and 25.9±3.9 at the duodenum. Despite similar mean NAN flows and NAN/DMI between sampling sites (SS), 65% of the reported MN flows to omasum exceeded 300 g/d whereas only 32% of the reported MN flows to duodenum were greater than 300 g/d. As a result, MN represented more than 55% of the postruminal NAN flow in 90% of the cases in which samples were taken from the omasum compared with 39% of the cases in which samples were obtained from the duodenum. Both data sets were combined and subjected to regression analysis using a mixed model approach that included study as a random variable. Dependent variables were NAN, MN, and NANMN flow. Independent variables were SS, NI or DMI and dietary CP %, and all possible two-way interactions. The effect of SS and its interaction with other variables was not significant ($P > 0.25$) for all NAN-flow models. Conversely, the interactions SS x DMI and SS x NI were significant for the MN-flow ($P < 0.06$) and NANMN-flow ($P < 0.01$) models, respectively. These findings suggest that omasal canal and duodenal sampling may result in different estimates of the flow of MN and NANMN. More research is needed to determine the relative accuracy of these estimates and origin of these differences.

991 Essential oil supplementation of a corn silage based diet deficient in rumen undegraded protein fed to lactating Holstein dairy cows. C. A. Crawford, C. G. Schwab, A. B. Conroy, P. S. Erickson, N. L. Whitehouse*, and S. E. Boucher, *University of New Hampshire*, *Durham*.

Thirty multiparous Holstein cows in early lactation were used in a randomized complete block design to determine the efficacy of adding VERTAN, a specific blend of essential oils (EO), at 0 or 0.8% of diet dry matter (DM) to a corn silage based diet on DM intake, milk yield (MY), milk composition, and ruminal N metabolism. The basal diet contained (DM basis) 29.8% corn silage, 14.9% grass silage, 7.2% alfalfa hay, 0.11% grass hay, 21.5% finely-ground corn, 1.6% beet pulp, 1.6% citrus pulp, 4.3% soy hulls, 0.79% molasses, 11.9% soybean meal, 0.43% urea, 0.06% Smartamine M™, 2.5% Megalac™, and 3.4% vitamin and mineral premix. Animals were on treatment from 21 through 105 days in milk. Diets were formulated to meet NRC (2001) requirements for energy and all nutrients except rumen undegraded protein. Cows were fed and milked 3 × daily. Milk and blood samples were collected during wk 4-15 of lactation. There was no effect of VERTAN supplementation on DM intake, MY, milk composition, or blood urea N concentrations. To evaluate the effects of VERTAN on ruminal N metabolism, 2 rumen cannulated multiparous Holstein cows were used in a switchback design (each cow received each treatment twice). Experimental periods were 4 wk; 16 rumen fluid samples were collected during wk 4 of each period. Samples were collected during 2 consecutive days to represent every 2 h in a 24-h period. There was no effect of treatment on ruminal pH. A significant hour by treatment effect was observed for ruminal ammonia-N concentrations; VERTAN supplementation lowered ruminal ammonia-N concentrations at 2, 3, and 4 h post-feeding. These results support the work of others indicating that EO decrease amino acid (AA) deamination in the rumen. More research is needed to determine the interactions of supplementation levels of EO, diet composition, and rumen ammonia-N and free AA concentrations in lactating cows.

Key Words: Lactating Cows, Essential Oils, Corn Silage

992 The effect of rumen undegradable and rumen degradable protein concentration on urea recycling in mid-lactation cows. S. K. Ivan*[1], R. L. Baldwin, VI[2], and R. A. Kohn[1], [1]*University of Maryland*, *College Park*, [2]*USDA-ARS*, *Beltsville, MD*.

This study investigates potential mechanisms for control of urea recycling. We assigned 8 mid-lactation Holstein cows to a repeated 4

× 4 latin square, balanced for carryover effects. The isoenergetic diets contained 16.0, 17.3, 18.8, and 19.5% CP as a percent of DM, and the rumen degradable (RDP) and rumen undegradable protein (RUP) concentrations were arranged in a factorial design (10.0 and 12.5% RDP and 5.6 and 8.1% RUP as a percent of DM). There was no effect (P>0.05) of CP concentration on rate (g/d) of urea recycling, urea transferred to the GIT, or urea returning to the blood from the GIT. Of the urea transferred to the GIT, the proportion utilized by the microbes was also unaffected by CP concentration. Analysis of the RUP and RDP factorial identified tendencies for greater urea transfer (g/d) to the GIT with the low RDP diets (P=0.08), and for greater return of recycled urea to the blood (g/d; P=0.10). The blood urea N (BUN; mg/dL) was lowest for the low RDP diets but low BUN did not decrease transfer of urea to the GIT. As a proportion of urea transferred to the GIT there was more returned to the blood (P=0.05) with the high RUP diets, and a tendency (P=0.11) for more urea utilization by the rumen microbes with the low RUP diets. There was no difference in the liters of blood cleared of urea by the kidney per day per kg body weight indicating that any regulation of recycling is not at the kidney. We did not observe ruminal urea transporter (bUT-B2) expression changes. The rate of transfer of urea across the rumen wall appeared to be independent of rumen and blood urea concentrations, thereby increasing the proportion of BUN and rumen ammonia N (RAN) transferred when low protein diets decrease the BUN and RAN concentrations.

Key Words: Urea Recycling, Rumen Degradable Protein, Rumen Undegradable Protein

993 Nitrogen excretion and utilization efficiency in dairy sheep fed diets with different dietary energy contents. V. Giovanetti[1], M. Decandia[1], F. Boe[2], E. Zerbini[3], A. Cannas[2], and G. Molle*[1], [1]*Istituto Zootecnico e Caseario della Sardegna*, *Olmedo, Sardinia, Italy*, [2]*Dipartimento di Scienze Zootecniche, Università di Sassari*, *Sassari, Sardinia, Italy*, [3]*Cargill Animal Nutrition*, *Spessa, Italy*.

The aim of this study was to evaluate a) the effect of different dietary energy content on fecal N excretion (FNE), urinary N excretion (UNE) and N utilization efficiency (NUE), and b) the relationships between milk urea N (MUN) and the above variables in Sarda dairy ewes. Two experiments were carried out using mid lactating (E1) and late lactating (E2) dairy ewes (n=5 per treatment), kept in metabolic cages and fed 8 pelleted diets with different main ingredients: Corn Meal (CM), Wheat Middlings (WM), Corn Flaked (CF), Barley Meal (BM), Corn Cobs (CC), Beet Pulp (BP), Alfalfa (AA) and Soybean Hulls (SH). The diets ranged from low (1.26-1.53 Mcal/kg DM) to high (1.72-1.84 Mcal/kg DM) NEL contents, and had high CP concentration (on average 18.4 % DM). The lowest energy diet (AA) showed a trend to higher N excretion and MUN and lower NUE (Table 1). Pooling all data, a close positive relationship was found between UNE and MUN (R^2=0.94), while FNE was positively related to NDF and negatively to NFC (R^2=0.82 for both). A negative relationship between MUN and NUE was also found (R^2=0.58). It is concluded that diets with s high energy content can reduce overall N excretion and increase NUE in dairy sheep. In addition, MUN can be effectively used to predict urinary nitrogen excretion and NUE.

Table 1.

Diets		CM	WM	CF	BM	CC	BP	AA	SH
NEL Mcal/kg DM		1.79	1.72	1.84	1.72	1.53	1.76	1.26	1.47
FNE g/d	E1	9.6^{d}	10.8^{cd}	11.5^{cd}	10.9^{cd}	20.3^{ab}	14.5^{bd}	16.4^{bc}	23.8^{a}
	E2	6.1^{c}	nd	8.1^{bc}	12.2^{ab}	18.0^{a}	16.5^{a}	16.5^{a}	16.5^{a}
UNE g/d	E1	16.5^{bc}	17.5^{bc}	14.3^{c}	15.5^{bc}	24.9^{ab}	16.3^{bc}	29.5^{a}	22.2^{ac}
	E2	17.9^{b}	nd	17.8^{b}	22.0^{b}	22.0^{b}	21.4^{b}	38.0^{a}	24.3^{b}
MUN mg/dl	E1	15.6^{c}	18.1^{bc}	15.6^{c}	16.9^{bc}	22.6^{ab}	16.2^{bc}	26.7^{a}	20.3^{ac}
	E2	17.6^{c}	nd	17.9^{c}	21.5^{bc}	21.0^{bc}	18.1^{c}	34.0^{a}	26.2^{b}
NUE %	E1	18.5^{ac}	21.9^{ab}	23.9^{a}	21.7^{ab}	13.8^{cd}	21.3^{ab}	12.6^{d}	16.9^{bd}
	E2	20.3	nd	16.2	16.9	10.7	14.1	9.7	15.1

a, b, c, d: within rows differ (P<0.05).

Key Words: N Utilization, Milk Urea, Sheep

Teaching/Undergraduate & Graduate Education: Swine Teaching

994 Enrollment in swine classes at 49 four-year institutions during academic years 1998-99 to 2005-06. D. E. Reese*, K. M. Eskridge, and D. A. Travnicek, *University of Nebraska*, *Lincoln*.

Concern over enrollment decline in swine classes (SC) at some institutions was discussed at a North Central Region Animal Science department head meeting in 2003. The lack of quantifiable nation-wide enrollment information prompted an effort to collect SC enrollment data from 49, four-year US institutions. Enrollment data was obtained for each institute's SC beginning with the 1998-1999 academic year (AY) though 2005-2006. If no enrollment was reported, follow-up contact was made to discern whether 1) the SC was offered but not taught due to low enrollment (LE), 2) the SC was not offered (NO), 3) the SC was scheduled not to be offered (SNO), or 4) no SC existed. Regression analyses were performed with AY as the independent variable to test if the slope was zero for number of students enrolled, percent of SC that were taught (SCT), percent of institutions experiencing LE, percent of institutions experiencing NO, percent of institutions experiencing SNO, and percent of institutions teaching a SC with < 10 students enrolled. Forty-one institutions had a SC during 1998-99 to 2002-03; forty had a SC from 2003-04. The number of SC ranged from 43 to 46 depending on the AY. Enrollment in SC and the percent of SC that were taught decreased from 1998-99 to 2005-06 (see table). More institutions that had a SC did not offer their SC in 2005-06 vs. 1998-99, while those teaching their SC with < 10 students was stable. These results demonstrate that low enrollment and course offering issues exist with SC at many institutions.

Table 1. Swine class enrollment and offerings

AY	No. students	SCT,%	LE,%	NO,%	SNO,%	<10 students,%
98-99	914	84	2	2	7	20
99-00	893	80	7	2	5	32
00-01	839	85	7	0	10	39
01-02	778	74	17	2	10	24
02-03	679	67	12	12	12	29
03-04	662	71	13	8	13	30
04-05	668	68	10	8	18	33
05-06	808	73	8	10	13	20
Slope:	-29.7[b]	-2.1[b]	0.7	1.4[b]	1.4[a]	-0.2

[a]P<0.01;[b]P<0.05.

Key Words: Swine, Teaching, Enrollment

995 Regionalization of teaching efforts? - Midwest Poultry Consortium experience. M. M. Beck*[1] and B. C. Wentworth[2], [1]*Clemson University*, *Clemson, SC*, [2]*University of Wisconsin*, *Madison*.

In 1993, faced with declining poultry programs at Midwestern universities and decreasing numbers of graduates with training in poultry science, a group of poultry producers, processors, and allied industry executives formed the Midwest Poultry Consortium (MPC) for the express purpose of supporting a regional teaching program. Faculty and administrators at the University of Wisconsin were instrumental in the development and implementation of the Midwest Poultry Science Undergraduate Center of Excellence (COE), to which initially 13 universities contributed funds and committed faculty time. With a representative of each university in attendance (the Coordinating Council) in 1995, a two-summer, six-course academic program was developed. Industry members of the MPC pledged their assistance and assurance in securing internships for students before and/or after the classes. Funding obtained from MPC members provides student travel to and from Madison, dorm room costs, in-state tuition, and course supplies and materials; and travel, a per diem, and accommodations in the UW Extension hotel for faculty. Faculty salary is not covered. Credits transfer back to home institutions. Nineteen students attended the 1st COE in Madison, WI, in 1996; ten years later, some 188 students have attended COE classes. A 2005 survey of students through 2004, with a response rate of 58%, showed that ~58% of respondents had completed all six courses; 64% had had at least one internship. Of those 1996-2000 COE participants currently employed in the poultry industry, the average salary is $46K (range $20K-$95K) in contrast to $39K (range $15K-$75K) for those not employed in the industry. Faculty participation has been remarkably constant and industry support has not wavered. A strength of the program is the very tight camaraderie that develops among the students and that continues as they move into industry positions in the poultry industry. In 2001, the Midwest Poultry Research Program was initiated to address issues of importance to the Midwest poultry industry.

Key Words: Regionalization, Teaching, Midwest Poultry Consortium

996 Regionalizaton of swine teaching efforts. D. J. Meisinger*, *US Pork Center of Excellence*, *Ames, IA*.

The mission of the US Pork Center of Excellence (USPCE) is to add value to the pork industry by facilitating research and learning for U.S. pork producers through national collaboration. The USPCE is bringing states together in a collaborative mode to accomplish many things in research, teaching and extension. Regionalizing swine teaching is definitely within the purview of the USPCE strategy. The first tool of the Center is the Pork Information Gateway (PIG), a virtual library of resources for pork producers and educators. Another tool available only to educators is PIGMAP or the PIG media asset portal which contains a large number of images. PIG will provide a convenient repository for all teaching materials allowing educators involved in teaching swine classes an opportunity to draw upon a wealth of material as they prepare lesson plans. The images would be a great addition to this body of material as well. Another related program being proposed by the USPCE is the concept of regional swine schools. These schools would provide for specific student centered instruction in pork production at central locations allowing the students to return to their respective universities to conclude their education. Much of the curricula developed for these schools would be made available to all swine class instructors through the PIG website to enhance their ability to teach modern pork industry practices, strategies and philosophies. The USPCE is poised to offer swine class instructors an opportunity to draw upon many resources as they prepare their lesson plans and build their curricula. This concept of assembling all the materials critical to preparing young people for future careers in the pork industry is sound and should be supported.

Key Words: Swine Teaching, Swine Curricula, Swine Instruction

997 Student perceptions of and enrollment in swine management courses at North Carolina State University. W. L. Flowers*, *North Carolina State University*, *Raleigh*.

The Department of Animal Science has surveyed incoming freshmen and graduating seniors for the past 10 years. None of the incoming freshmen (n=140 per year) have an interest in swine. In contrast, 10 to 15% of the graduating seniors (n=100) list swine as their primary species of interest or indicate they have accepted a position in the swine industry. Exposure to pigs early during a student′s academic program and a senior-level management course that focuses on problem-solving appear to be two factors that foster this change. Both courses are taught by the same instructor. All freshmen are required to take the introductory animal science course. This course has two laboratories that focus on swine. One is a behavior laboratory, which is the first scheduled laboratory. Students participate in quantifying behavioral interactions between sows and piglets. During a subsequent laboratory, students assist sows during farrowing and obtain blood samples from weaned pigs. Course evaluations indicate that the laboratories dealing with swine are the student's favorite. Access to sows and piglets and participating in events in which students felt they contributed to the animal′s well being are the two common reasons given. The senior-level management course is a departmental elective with enrollment capped at 30 students. Examinations require students to work in groups to solve simulated problems. Students have to analyze production records and identify problems. For each problem, they are required to gather information that will help them explain its cause(s). They have to rely on their own observations of the farm; data that they collect such as ventilation efficiency, feed intake, or semen quality; data that

they can request such as feed analyses, necropsy reports, or serology profiles; and questions they can ask of the employees. Previous exposure to swine in the introductory course and the interactive nature of the examinations consistently rank as the main reasons students enroll in the senior-level swine management course.

Key Words: Swine, Teaching

998 A survey of student demographics enrolled in a distance education swine production class. R. D. Goodband* and B. C. Minshal, *Kansas State University*, *Manhattan*.

Kansas State University is one of the few universities where enrollment in its swine production class, Swine Science, ASI 535, has gradually increased over the past 5 years. While enrollment in the on-campus class has remained steady at approximately 22 students in both fall and spring semesters, the gradual increase in student numbers has been a result of the introduction of a distance education, internet-based class. The on-campus and distance education classes are virtually identical in course content, with the exception that the distance class does not have a laboratory. As a substitute for laboratories, a DVD with video footage of some of the on-farm activities is distributed. Also, the distance education class is designed for students to work at their own paceSince spring of 2002, there have been 221 students who have taken the on-campus class (57% of students in the fall semester and 43% in the spring), whereas 64 students have taken the distance education class which is offered in fall (25%), spring (45%) and summer (30%) semesters. Of these distance education students, 37% are male and 63% female. Sixty seven percent are KS residents and 33% from other states. Of students enrolled, 56% are also full-time KSU students concurrently enrolled in on-campus classes. The other 44% are only taking classes from KSU via distance education (not enrolled in any on-campus classes). In the spring and fall semesters, 44% are on-campus students and 54% are not. However in the summer semester, 84% are full time KSU students. This suggests that on-campus students want to take classes during the summer semester when traditional animal science classes are typically not offered. It may also suggest a trend in more students wanting to take classes year round compared with the traditional fall/spring semester system. Distance education classes appear to offer scheduling flexibility, especially during the summer semester for students to complete their degree programs.

Key Words: Distance Education, Swine Production, Teaching

999 Teaching swine production as a capstone experience in the writing intensive curriculum. T. J. Safranski*, *University of Missouri*, *Columbia*.

From 1998-2006 the senior level Swine Production course at the University of Missouri was taught by the same instructor as a Capstone Experience in the Writing Intensive (WI) curriculum. For WI status assignments are reviewed and meet guidelines set by the Campus Writing Board to ensure rigor and include revision and critical thinking. Writing skills are learned using the ′writing across the curriculum′ concept, with students required to take one lower level WI class and one upper level WI class within their major. One writing class is required. Completion of one Capstone Experience is also required. Departmental guidelines require students complete two production courses choosing among Swine, Beef, Dairy, Poultry and Horse; four of the five are WI; all are Capstone. Swine Production was cancelled once with enrollment of six (1999). Otherwise enrollment ranged from 11 (2001) to 46 (2004) and averaged 26.1 students. Although assignments evolve, in 2006 there were 14 assignments, seven of which involved multiple drafts. Four of these seven involved developing a five year plan for a commercial farm working in instructor-assigned teams. Papers total a minimum of 33 pages of writing; most students write more. Many papers are short and used to force students to consider issues prior to class discussion. Normally less than 15% of students are enrolled specifically to meet the WI requirement. Student evaluations indicate the writing is not perceived as excessive. The most common complaint is coordinating teams, although the Farm Plan is also normally rated among the two best assignments of the class. Besides writing, other activities students often praise include the required one or two day field trips to commercial farms and an optional job shadowing experience. Rarely have more than 20% of students been to a swine farm. Teams prepare a 10 minute seminar on their field trip experience and present to the rest of the class. Incorporation of writing into a senior level Swine Production course may enhance student learning. It requires significant time investment for grading by the instructor.

Key Words: Swine Production, Teaching, Writing

American Dairy Science Association
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Abstract numbers preceded by M are Monday posters, numbers preceded by T are Tuesday posters, and numbers preceded by W are Wednesday posters; all other numbers indicate oral abstracts.

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ABSTRACTS
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*Author presenting paper

SYMPOSIA AND ORAL SESSIONS

Monday, January 22
Physiology and Pathology
Room: B312

M1 Comparison of delayed type hypersensitivity reaction induced in chickens, turkeys and ducks by killed *Staphylococcus aureus*. O. A. Oladele*, A. A. Owoade, and T. O. Jolaoso, *University of Ibadan*, *Ibadan, Oyo State, Nigeria*.

Differentials in susceptibility of poultry species to a number of avian pathogens prompted the comparison of innate cellular immune response of chickens, turkeys and ducks via the assessment of delayed type hypersensitivity (DTH) reaction in these species. Delayed footpad reaction (DFR) to killed *Staphylococcus aureus* was adopted for this study.

Twelve broiler chickens, 16 turkeys and 8 ducks were sensitized twice via subcutaneous injection in the neck of *S. aureus* antigen (150µ/g) mixed 1:1 with Complete Freund Adjuvant (CFA) at 3 and 4 weeks of age. Control birds were injected with CFA only. At 6 weeks of age the birds were challenged intradermally with *S. aureus* antigen (75µg/bird) in Phosphate Buffered Saline (PBS) in the right footpads while the left footpads were injected with PBS only. The thickness of the footpads was measured at 0, 5, 12, 24, 48 and 72 hours (hrs) post challenge (pc) to evaluate DFR. At 72 hrs pc birds were euthanized and both footpads were excised for histopathology. In a second experiment spleens from both sensitized and non-sensitized broilers were separately harvested aseptically; splenic lymphocytes (SL) were prepared and injected intravenously into 2 groups of recipient broilers.

Average DFR values obtained in sensitized birds were generally higher than in non-sensitized birds and was statistically significant (P≤×0.5)between 24 and 72 hrs pc in chickens and at 12 hrs pc in turkeys. While maximum DFR response was at 24 hrs pc in broilers it was at 12 hrs in both turkeys and ducks. At histopathology the killed *S. aureus* injected footpads were characterized by dermal oedema, congestion of blood vessels and perivascular infiltration of lymphocytes and macrophages. Broiler chickens that received sensitized SL had a significantly pronounced DFR following challenge with *S. aureus* antigen in comparison with those that received non-sensitized SL.

This study has shown that while turkeys and ducks have innate ability to elicit faster cellular immune response to *S. aureus* antigen than chickens, chickens have the innate ability to respond more intensely.

Key Words: Innate cellular immunity, DTH reaction, Chickens, Turkeys, Ducks

M2 Effects of luteinizing hormone, follicle stimulating hormone, 17 β-estradiol or testosterone upon ghrelin receptor mRNA expression in cultured granulosa cells. M. E. Freeman* and A. J. Davis, *University of Georgia*, *Athens*.

Nutritional status and reproductive function are intricately connected. However, the complex hormonal interactions defining how nutrition effects reproduction have yet to be clarified. Ghrelin is a novel polypeptide hormone produced predominantly in the proventriculus of chickens that effects feed intake and energy metabolism. There is increasing evidence that ghrelin also directly affects reproduction in mammalian species. Previously we reported that ghrelin receptor (GHSR) mRNA was expressed in both the theca and granulosa cells of developing follicles of the ovary and that theca mRNA expression of GHSR increased significantly in fasted hens. In the current research the gonadotropin and steriod hormone regulation of GHSR mRNA expression was examined. For each replicate experiment granulosa cells were isolated from the F_1 and F_3 follicles and small yellow follicles (SYF) from three hens. The isolated and dispersed granulosa cells were then cultured for 24 hours in the absence or presence of 50 ng/mL of LH or FSH (5 replicate experiments) or in the presence or absence of 1 x 10^{-6} M of testosterone or 17 β-estradiol (4 replicate experiments). For each experiment, total RNA was extracted from the freshly dispersed granulosa cells and the cultured granulosa cells from each follicle size for two step real-time PCR analysis of GHSR. Untreated, cultured granulosa cells from all follicle sizes had significantly greater expression of GHSR than freshly dispersed granulosa cells. In the cultured granulosa cells isolated from the F_1 and F_3 follicles the addition of LH, FSH and testosterone, but not 17 β-estradiol, significantly decreased the mRNA expression of GHSR. In the granulosa cells isolated from SYF, expression of GHSR was

equal in the untreated control cells and the cells cultured with any of the hormones. The lower expression of GHSR in the presence of gonadotropins and testosterone indicate that these hormones may play a vital role in down-regulating GHSR expression in the granulosa cells of hierarchal preovulatory follicles.

Key Words: Ghrelin receptor, Granulosa, Gonadotropin, Steriod

M3 Compensatory changes to induced anemia in broilers. L. L. Hale-McWilliams*, Z. Williams, M. Putsakum, S. W. Anderson, and J. P. Thaxton, *Mississippi State University*, *Mississippi State*.

Experiments were conducted to evaluate compensatory changes to induced anemia in broilers in 4 wk-old broilers. Five treatments were used and these were non-bled and bled controls plus bled controls that received iv injections of saline (SAL), chick embryo extract (CEE) or anemic chick serum (ACS). The CEE extract was prepared by pooling 200, 10 d broiler embryos in 10 mL of PBS, homogenizing the embryos using a Stomacher blender, and then filtering the homogenate at 0.4 mmic. The ACS was prepared by collecting serum from 4 wk old chicks that were subjected to severe anemia by multiple bleedings. Additions of 7 mL (iv) of SAL, CEE, and ACS were made immediately after a 10% blood loss (v/BW basis). Thereafter, birds were bled at 5 min, 2 h, 24 h and 72 h to assess pH, pCO2, pO2, hematocrit, hemoglobin, electrolytes (Na+, K+, Ca+2, Cl-, and HCO3-), anion gap, and plasma corticosterone . The spleen and bone marrow samples were also evaluated for relative weight and hemoglobin levels. Results suggest that homeostatic regulation of acid-base balance were achieved within 72 h; however, physiological compensations of the induced-anemic condition had not been completed within 72 h.

Key Words: Anemia, Broilers, Hematocrit, Hemoglobin, Erythropoietin

M4 Evaluation of novel bacterial species on intestinal development and microflora. B. S. Lumpkins*, Y-J. Cho, A. B. Batal, and M. D. Lee, *University of Georgia*, *Athens*.

The growing concern of feeding antibiotics to poultry has lead researchers and animal health companies to investigate alternatives. An experiment was conducted to evaluate the effects of an oral inoculation with novel intestinal anaerobes on the development of the intestine. At 0d of age, 500 Cobb male chicks were separated into 4 treatments: a control and 3 test treatments that were orally inoculated with a novel species of *Bacteroidaceae, Clostridiaceae*, or a combination of the two. Throughout the experiment all birds were fed a corn-soybean meal diet. At 0, 1, 2, 3, 7, 16, and 42d of age performance parameters were measured and samples were taken for morphological and bacterial community analysis. At 42d of age, birds were randomly selected and processed for carcass yield. For bacterial community analysis, community DNA isolated from small intestinal contents were amplified with universal 16s primers. Diversity and compositional changes were assessed using denaturing gradient gel electrophoresis (DGGE) and terminal restriction fragment length polymorphism (T-RFLP). The performance parameters were similar among all 4 treatments from 0 to 16d of age. At the end of the 42d period the overall weight gain of the birds inoculated with *Clostridiaceae* was significantly lower than the control birds and the *Bacteroidaceae* inoculated birds. The birds inoculated with the combination of *Bacteroidaceae* and *Clostridiaceae* had increased villi height and goblet cell concentration during the first 3d of age, but after 7d of age there was no overall difference in morphological response between treatments. There was no difference in the carcass yield between treatments. Based on the DGGE analysis, the microbiota populations clustered based on age rather than treatment. Birds inoculated with either *Bacteroides* or *Clostridiaceae* had a higher proportion of lactobacilli in the ileum compared to the control birds, based on T-RFLP analysis at 42d of age. The combination of *Bacteroidaceae* and *Clostridiaceae* improved intestinal development at young ages, but *Clostridiaceae* may have negative effects on weight gain during the latter stages of growth.

Key Words: Microbiota, Morphological, Anaerobes, Bacterial community, DNA

M5 Effect of age on intestinal pH of broiler chickens. J. M. Rynsburger* and H. L. Classen, *University of Saskatchewan*, *Saskatoon, SK, Canada*.

Protein digestion has been shown to be relatively poor in young birds therefore it is of interest to identify limiting factors. Initial protein digestion involves hydrochloric acid denaturation of protein and conversion of pepsinogen to its active form in the proventriculus and gizzard. If the production of hydrochloric acid is limited in young broilers, protein digestion may be hampered. A one-way ANOVA was used to study the effect of age on intestinal pH of broiler chickens fed a broiler starter diet. Ross x Ross 308 broilers (150 males) were randomly assigned to 10 battery cages. Using one bird per cage per sample age, the pH of the crop, proventriculus, gizzard, duodenum, jejunum and ileum was measured at 2, 3, 4, 5, 6, 7, 8, 9, 10 and 15 days of age. As the birds got older the crop pH increased (2d-5.01, 3d-5.51, 4d-5.64, 5d-5.54, 6d-5.42, 7d-6.13, 8d-5.08, 9d-5.56, 10d-6.29, 15d-6.02) while the pH of the proventricular proventriculus and gizzard decreased (proventriculus: 2d-5.20, 3d-5.12, 4d-4.78, 5d-4.58, 6d-3.33, 7d-4.85, 8d-4.16, 9d-3.48, 10d-3.56, 15d-3.37; gizzard 2d-3.49, 3d-3.47, 4d-3.43, 5d-3.50, 6d-3.24, 7d-3.48, 8d-3.30, 9d-3.42, 10d-3.27, 15d-3.27). The relationship between age and intestinal pH for the duodenum, jejunum and ileum was quadratic (duodenum: 2d-6.57, 3d-6.37, 4d-6.30, 5d-6.45, 6d-6.42, 7d-6.07, 8d-6.23, 9d-6.35, 10d-6.47, 15d-6.40; jejunum: 2d-6.82, 3d-6.66, 4d-6.44, 5d-6.5, 6d-6.38, 7d-6.3, 8d-6.26, 9d-6.34, 10d-6.42, 15d-6.5; ileum: 2d-7.74, 3d-7.07, 4d-7.26, 5d-7.1, 6d-6.74, 7d-7.08, 8d-6.9, 9d-7.05, 10d-7.43, 15d-8.15). In conclusion, during the first week of age the pH of the proventriculus and gizzard decreases indicating that the production of hydrochloric acid may not reach optimal levels until some time after hatch. As a result, protein digestion may be hampered during the first week post-hatch.

Key Words: Intestinal pH, Broiler, Chick, Protein, Digestibility

M6 Gonadotropin and steroid hormone regulation of zona pellucida proteins C and D messenger RNA in chicken granulosa cells. A. P. Benson*, M. E. Freeman, J. B. Hoffman, and A. J. Davis, *University of Georgia*, *Athens*.

The freshly ovulated ovum in avian species is surrounded by a protein layer called the inner perivitelline layer (IPVL), which is equivalent to the zona pellucida in mammals. For successful fertilization, sperm must attach and penetrate the IPVL. Previous research has established that

two of the IPVL protein components, ZPC and ZPD, are synthesized by the granulosa cells of the hierarchical follicles of the chicken ovary. In the current research, gonadotropin (LH and FSH) and steroid hormone (estrogen and testosterone) regulation of both ZPC and ZPD mRNA expression was investigated in cultured granulosa cells, which were isolated from the F1, F3, or small yellow follicles (SYF) from three broiler breeder hens for each replicate experiment. Isolated and dispersed granulosa cells from each follicular size were cultured for 24 hours in the absence or presence of 50 ng/ml of culture media of LH or FSH (4 replicate experiments), or in the presence or absence of 1 x 10^{-6} M testosterone or 17 β-estradiol (4 replicate experiments). For each experiment, total RNA was extracted from freshly dispersed granulosa cells and the cultured granulosa cells from each follicle size for subsequent Northern blot analysis of ZPC and ZPD. Neither ZPC nor ZPD mRNA were detected in freshly isolated granulosa cells from (SYF), however, both ZPC and ZPD mRNA expression was detected in untreated SYF granulosa cells cultured for 24 hours. ZPC and ZPD mRNA expression was also further up-regulated in SYF granulosa cells cultured in the presence of LH or testosterone. FSH increased ZPD mRNA expression in SYF granulosa cells. F3 granulosa cells cultured with FSH had higher ZPC and ZPD mRNA expression levels than untreated control cells. The mRNA expression of ZPD was higher in F3 granulosa cells cultured with testosterone and estrogen. The addition of LH to F1 granulosa cells lowered the mRNA expression of ZPC but not ZPD. These results indicate that gonadotropins and steroid hormones may play vital roles in regulating the expression of the mRNA for ZPC and ZPD in the granulosa cells of developing preovulatory follicles in the hen.

Key Words: Zona pellucida, Hormones, Granulosa

M7 Hormonal regulation of the activin type IA and IB receptors during follicular development in broiler breeder hens. J. B. Hoffman*, M. E. Freeman, A. P. Benson, and A. J. Davis, *University of Georgia*, *Athens*.

Increasing research evidence suggests that the activin and inhibin family of proteins have regulatory roles in chicken follicular development. Activin's cell surface receptor complex consists of an activin type I (ActRI) receptor and an activin type II receptor. Previously, we detected and profiled the expression pattern of the mRNA for two forms (ActRIA and ActRIB) of the ActRI receptor in the theca and granulosa cells of preovulatory hen follicles. In the current research, gonadotropin (LH and FSH) and steroid hormone (estrogen and testosterone) regulation of ActRIA and ActRIB mRNA expression was investigated in cultured granulosa cells, which were isolated from the F1, F3, or small yellow (SY) follicles from three broiler breeder hens for each replicate experiment. Isolated and dispersed granulosa cells from each follicular size were cultured for 24 hours in the absence or presence of 50 ng/mL of culture media of LH or FSH (5 replicate experiments), or in the absence or presence of 1 x 10-6 M testosterone or 17 -β estradiol (4 replicate experiments). Total RNA was extracted from all the cultured granulosa cell samples for subsequent real-time RT-PCR analyses of ActRIA, ActRIB and GAPDH (endogenous control) mRNA expression using gene specific primer pairs and a Taqman minor groove binding probe for each message. Granulosa cells obtained from F1 or F3 follicles and treated with LH had significantly lower mRNA levels of ActRIA and ActRIB than untreated granulosa cells. Similar results were obtained for FSH, except FSH did not significantly depress the mRNA expression of ActRIA or ActRIB in F1 granulosa cells. The expression of the mRNA for ActRIA and ActRIB in granulosa cells cultured from SYF was unaffected by the gonadotropins. Estrogen had no effect on the mRNA expression of ActRIA and ActRIB. The addition of testosterone to the granulosa cell cultures decreased the mRNA expression of ActRIA in F1 granulosa cells. The results suggest that the presence of LH and FSH in vivo may decrease the sensitivity of granulosa cells in hierarchical follicles to activin.

Key Words: Activin receptor type I, Broiler breeder hens, Follicular development

M8 Parthenogenesis discovered in unfertilized eggs of *Coturnix chinensis*, the Chinese painted quail. C. D. McDaniel* and H. M. Parker, *Mississippi State University*, *Mississippi State*.

Parthenogenesis, embryonic development of an unfertilized egg, has been studied for many years in turkeys. In fact, as many as 49% of unfertilized Beltsville Small White turkey eggs develop embryos. However, virtually no research exists on parthenogenesis in quail. The Chinese painted quail is a close relative of the more common Japanese quail and, unlike turkeys or chickens, the small Chinese painted quail reaches sexual maturity rapidly, making it a great candidate for further research on parthenogenesis. Obviously, a better understanding of avian parthenogenesis will increase our knowledge of avian fertilization and early embryonic development. Therefore we determined if unfertilized Chinese painted quail hens produce embryos. Secondly, we explored the possibility that position of the egg within the clutch influenced the rate of parthenogenesis. When initial secondary sexual plumage was apparent at 4 wk of age, male chicks were separated from females to prevent fertilization. Hens were placed in individual cages near sexual maturity, at approximately 8 wk of age. Individual eggs were collected daily and labeled with the hen number and date. Eggs were stored for 0 to 3 days at 20 C prior to incubation at 37.5 C. After 10 days of incubation, approximately 8,000 eggs from 308 laying hens were examined for embryonic development under a magnifying lamp. On average, 4% of the unfertilized eggs contained embryonic development consisting solely of unorganized membranes. About 37% of the laying hens produced at least one parthenogenetic embryo. However, about 9% of the hens exhibited a predisposition for parthenogenesis by producing 4 or more unfertilized eggs with embryos. One hen even produced 8 embryos from 25 unfertilized eggs laid. Additionally, the first egg laid in a clutch was most likely to produce an embryo, with a steady decline in the percentage of eggs developing embryos as position in the clutch increased. In conclusion, the Chinese painted quail does exhibit parthenogenesis and appears to be an excellent animal model for studying parthenogenesis.

Key Words: Chinese painted quail, Parthenogenesis, Fertility, Embryo, Quail

M9 Effects of chronic administration of NOS inhibitors on cardiopulmonary function and ascites parameters in broiler chickens. C. A. Ruiz-Feria*, N. Rougiere, and S. Kawthekar, *McGill University*, *Ste. Anne de Bellevue, QC, Canada*.

Endothelial dysfunction and inability to produce nitric oxide (NO) has been associated with the development of pulmonary hypertension (PH). Two experiments were conducted to investigate the effects of

chronic administration (14 d) of aminoguanidine (AG, 50 mg / kg BW / day) a specific inhibitor of the inducible form of nitric oxide synthase (NOS); N-Nitro-L-Arginine Methyl Esther (L-NAME, 15mg /kg BW /day), a non-specific NOS inhibitor; and a control (CTL, tap water) on cardiopulmonary function and parameters related to PH. Pulmonary arterial pressure (PAP) and mean systemic arterial pressure (MAP) after an acute challenge of epinephrine (EPI, 0,5mg/kg BW) were evaluated in birds raised in a thermoneutral environment (Experiment 1). Starting at day 28, 8 clinically healthy birds per treatment were anesthetised, cannulated, and after 10 min of equilibration, EPI was injected. The PAP and MAP were continuously recorded. In Experiment 2 we measured hematocrit and electrocardiogram parameters in chickens raised in a cold environment starting at d 14. Basal levels of PAP were highest in the L-NAME group. The PAP increased 30 s after EPI in all groups, but the increase was lower in the CTL group than in the AG and L-NAME group. The increase in PAP after EPI was similar for the AG and L-NAME birds. The basal and peak MAP after challenge was higher in L-NAME group and lowest in the CTL group. Both NOS inhibitors increased the hematocrit percentage and reduced the RS wave amplitude compared with the CTL group, but AG and L-NAME had comparable effects. Those results suggest that iNOS is an important source of NO in chronic pulmonary hypertension

Key Words: Ascites, Nitric oxide, iNOS, eNOS

M10 Effects of pre-lay 6/85 strain *Mycoplasma gallisepticum* inoculation on the internal egg and egg shell characteristics of commercial laying hens when given alone or in conjunction with F-strain *Mycoplasma gallisepticum* inoculations during lay. K. A. Viscione*[1], E. D. Peebles[1], S. L. Branton[2], A. M. Vance[2], S. K. Whitmarsh[1], R. W. Keirs[1], and P. D. Gerard[1], [1]*Mississippi State University*, *Mississippi State*, [2]*USDA, ARS, Poultry Research Unit*, *Mississippi State, MS*.

Alterations in egg production in commercial layers in response to an F-strain *Mycoplasma gallisepticum* (FMG) infection at 12 wk of age have been shown to be associated with changes in yolk composition. Two trials were conducted to examine the effects of age of inoculation, a pre-lay 6/85 strain of *Mycoplasma gallisepticum* (6/85MG) inoculation, and FMG inoculation overlays during egg production on internal egg and eggshell characteristics of commercial laying hens. Inoculation treatments included: sham inoculation at 10 wk of age, 6/85MG at 10 wk of age, 6/85MG at 10 wk overlaid by a subsequent FMG inoculation at 22 wk, and 6/85MG at 10 wk overlaid by a subsequent FMG inoculation at 45 wk. Parameters assessed in each trial included egg weight; percent yolk, albumen, and eggshell weights; percent yolk moisture and lipid concentrations; yolk fatty acid profiles; eggshell weight per unit of surface area (SWUSA); egg shape index (width/length); and relative eggshell conductance (RG). Determinations of egg shape index, SWUSA, RG, and percent yolk moisture, yolk lipid, eggshell weight, albumen weight, and yolk weight were at various time periods between 24 and 59 wk, egg weight was weekly from 23 through 55 wk, and yolk fatty acid profiles at 59 wk. Parameters investigated before 45 wk were analyzed separately from those investigated after 45 wk. Egg shape index was higher at 49 wk compared to that at 53 wk. FMG overlays at 22 and 45 wk increased yolk moisture content. An FMG overlay at 22 wk increased yolk palmitic acid, and FMG overlays at 22 and 45 wk decreased yolk linolenic acid concentration. However, the 6/85MG inoculation at 10 wk alone increased yolk oleic acid concentration. In conclusion, a pre-lay inoculation of 6/85MG may increase yolk oleic acid concentration, whereas, FMG inoculations overlaid on a pre-lay 6/85 MG inoculation may further decrease yolk linolenic acid and increase yolk moisture palmitic acid concentrations.

Key Words: Albumen, Egg, *Mycoplasma gallisepticum* , Shell, Yolk

M11 Effects of supplemental dietary phytase and 25-hydroxycholecalciferol on the blood characteristics of cCommercial layers inoculated before or at the onset of lay with the F-Strain of *Mycoplasma gallisepticum*. E. D. Peebles*[1], S. L. Branton[2], M. R. Burnham[1], S. K. Whitmarsh[1], and P. D. Gerard[1], [1]*Mississippi State University*, *Mississippi State*, [2]*Poultry Research Unit,ARS, USDA*, *Mississippi State, MS*.

In 3 trials, the effects of dietary supplementation with phytase and 25-hydroxycholecalciferol on BW and the blood characteristics of commercial layers that were inoculated pre-lay (12 wk of age) or at the onset of lay (22 wk of age) with F-strain *Mycoplasma gallisepticum* (FMG) were assessed at 34, 50, and 58 wk of age. Experimental layer diets which included either a basal control diet or the same diet supplemented with 0.025 % phytase (600 FTU / kg of diet) and 0.025 % 25-hydroxycholecalciferol (250 ppm) were fed from 20 through 58 wk of age. The supplemented diet decreased blood hematocrit values across bird age, inoculation type (sham versus FMG), and age of inoculation (pre-lay versus onset of lay). Phytase and 25-hydroxycholecalciferol supplemented diets reduced bird BW in sham-inoculated control birds across bird age and age of inoculation. This effect was not observed in FMG-inoculated birds. Across inoculation type and age of inoculation, supplemented diets also reduced serum triglyceride levels in birds that were 34 wk of age. Furthermore, across diet (control versus supplemented) and inoculation type, total plasma protein concentration at 34 wk of age was higher in birds that were inoculated at the onset of lay compared to those inoculated pre-lay. Diet, inoculation type, and inoculation age had no effect on mortality, reproductive organ histopathological lesion scores, or serum cholesterol and calcium concentrations. In conclusion, throughout lay, the supplementation of commercial layer diets with phytase may lower hematocrit, and inoculation with FMG pre-lay or at the onset of lay may ameliorate the depressing effects of dietary phytase and 25-hydroxycholecalciferol supplementation on hen BW.

Key Words: FMG, Inoculation, *Mycoplasma gallisepticum*, Phytase, 25-hydroxycholecalciferol

M12 A comparison of performance of coccidia vaccinated broilers fed RepaXol®, AciXol™, or Bacitracin Methylene Disalicylate. G. Mathis*[1] and N. Scicutella[2], [1]*Southern Poultry Research, Inc.*, *Athens, GA*, [2]*SODA Feed Ingredients*, *Monaco*.

The objective of the study was to determine if RepaXol®, an homogeneus blend of double coated essential oils, AciXol™ a blend of organic and inorganic acids (citric, fumaric, malic and ortho-phosphoric) along with the protected essential oils (as in RepaXol® encapsulated in the same MICROPEARLS®, or Bacitracin Methylene Disalicylate (BMD), an antibiotic, in conjunction with a coccidiosis vaccine improves performance of broiler chickens grown to 42 days of age. The experiment consisted of 32 pens of 45 male broiler chickens. Floor space was 0.77 sq. ft. per bird. All chicks were spray vaccinated

with the label recommended dosage of Coccivac-B (coccidial vaccine) on day of hatch. The treatments were replicated in eight blocks, randomized within blocks of four pens each. The test treatments were nonmedicated (NM), RepaXol® 100 ppm, AciXol™ 500 ppm, or BMD 55 ppm, from Day 0 to 42. To confirm Coccivac-B viability and cycling, on Day 21 oocysts per gram litter were determined for all pens. Expected levels of oocysts were detected confirming viability of vaccine. There was a significant improvement in Day 42 feed conversion with all feed additives. The feed conversion of the NM birds was 1.842, RepaXol® 1.785, AciXol™ 1.792, and BMD 1.762. Average live weight gain showed a significant improvement with both RepaXol® and BMD. The weight gains of the NM birds was 2.123 kg, RepaXol® 2.210 kg, AciXol™ 2.165 kg, and BMD 2.230. The feed conversion and weight gain for RepaXol® and BMD were not significantly different. To evaluate the level of coccidiosis immunity, on Day 28, five representative birds were removed from each pen, given nonmedicated feed, and challenged with a mixture of E. acervulina, E. maxima, and E. tenella. Six days post inoculation, all birds were coccidiosis lesion scored. No interference with development of coccidial immunity was shown with any of the feed additives. RepaXol® 100 ppm, AciXol™ 500 ppm, and Bacitracin Methylene Disalicylate 55 ppm, in conjunction with a coccidiosis vaccine improved performance of broiler chickens.

Key Words: Coccidiosis, RepaXol™, AciXol™, BMD, Coccivac B

M13 Selenium sources influence small intestinal characteristics and morphology in reovirus infected broiler chickens. S. Burgos*[1], F. W. Edens[1], J. Read-Snyder[1], A. Cantor[2], and S. A. Burgos[3], [1]*North Carolina State University*, *Raleigh*, [2]*University of Kentucky*, *Lexington*, [3]*University of Guelph*, *Guelph, ON, Canada*.

Avian reovirus (ARV) infections have been associated with malabsorption syndrome causing lower weight gains in broiler chickens. The aim of this investigation was to determine if ARV infection with and without selenium -organic and inorganic- affected small intestinal characteristics and morphology. Eggs were obtained from Cobb breeders that had been maintained on isocaloric Torula yeast diets containing either no supplemental selenium, sodium selenite at 0.3 ppm, or organic selenium (SelPlex, Alltech, Inc., Nicholasville, KY, USA) at 0.3 ppm. Chicks hatched from those eggs were placed on Torula yeast broiler diets containing no supplemental selenium, 0.3 ppm sodium selenite, or 0.3 ppm organic selenium similar to their respective parents' diets. On the day of hatch, 60 chicks per dietary selenium treatment were placed into either control or ARV-infected groups in heated metal-growing batteries in separate isolation rooms. Chicks in the ARV-infected groups were given each an oral gavage of 0.2 mcL of ARV-CU98 ($10^{4.2}$ pfu/chick), and control chicks were given the medium only. At 23 d of age, the chicks were weighed, killed by carbon dioxide asphyxiation, and their intestinal tracts were dissected for total and segmental weight and length, with tissue collections for histomorphotography. Data from this 2 X 3 factorially arranged completely randomized experimental design were analyzed using the GLM procedure of SAS. The ARV-CU98 challenge caused more than 15% reduction ($p< 0.0003$) in body weight and caused 18.4% mortality compared with 6% in controls. ARV-CU98 infection did not affect intestinal length, but infected chicks had more distended and heavier intestines than did controls. Selenium reduced the average intestinal weight in both control and infected birds ($P<0.05$). Microscopic analysis revealed longer microvilli in selenium-fed control and infected birds, and goblet cell numbers were increased in selenium-fed birds. It was concluded that selenium is necessary to maintain the integrity of the small intestine of both control and ARV-CU98 infected chickens.

Key Words: Reovirus, Selenium, Broilers, Small intestine, Morphology

M14 Specificity of antibody to detection of reticuloendoteliosis virus in imunohistochemistry and in situ hybridization assay. V. Santos*, S. Williams, C. Brown, and J. Zhang, *University of Georgia*, *Athens*.

To assist the differential diagnosis of virus induced tumors in poultry, reticuloendotelisis virus (REV), Marekâ€™ disease virus (MDV) and avian leukosis virus (ALV), immunohistochemistry and an in situ hybridization assays for REV were developed. A collection of blocks that represent natural and induced cases of REV as well MDV and ALV were tested for specificity and sensitivity of the REV antibody and probe. The REV positive and negative controls were obtained by paraffin-embedded cells extracted from cell culture.

Key Words: Reticuloendoteliosis, Immunohistochemistry, In situ hybridization, Paraffin-embedded tissues, Natural and induced cases

Monday, January 22
Nutrition I
Room: B313

M15 Comparative study on quality of eggs from laying hens fed cocoa podhusk-based and farmers layer's mashes. R. A. Hamzat*[1], E. O. Uwagboe[1], M. A. Olumide[2], and M. T. Adeoti[3], [1]*Cocoa Research Institute of Nigeria*, *Ibadan, Oyo State, Nigeria*, [2]*Cocoa Research Institute of Nigeria*, *Ibadan, Oyo State, Nigeria*, [3]*Kolmart Farms*, *Ibadan , Oyo State, Nigeria*, [4]*Quadbis Farms*, *Ibadan, Oyo State, Nigeria*.

Cocoa podhusk (CPH) is a waste, constituting serious disposal problems on all cocoa farms in Nigeria. The use of CPH in feeding poultry, may alleviate the problem of high cost of feed ingredients which has occasioned the reduction in the rate of expansion of the poultry industry in Nigeria, as revealed by previous station trials. Hence, this study focused on the comparison of the effect of CPH based and farmers layers' mashes on the egg quality of laying hens.

A total of four hundred and ninety five, 3-month-in-lay birds were used for this on-farm trial. The birds were randomly distributed into 5 treatments replicated thrice with each treatment containing 99 layers, in a completely randomized design. These treatments were: 000 (Eggs from Control diet), 00A (Eggs from Farmer's feed 1), 00B (Eggs from Farmer's feed 2), 00C (Eggs from Farmer's feed 3), 00D (Eggs from Farmer's feed 4), 00E (Eggs from Farmer's feed 5). Each feed was fed adlibitum to the laying chickens. This trial lasted eight weeks. The

parameters measured included: egg weight, EW; egg length, EL; shell thickness, ST; shell weight, SW; yolk height, YH; yolk width, YW; albumin weight, AW; yolk colour score, YCS; yolk index, YI; and shell surface area, SSA. Eggs on layers mash OOB, was not significantly different (p<.O5) from OOA in all parameters studied, whereas significant differences (p<.05) occurred in other treatments as compared to the control. The overall ranking of the assessed feeds as revealed by the egg quality parameters studied was: OOA>OOB>OOD>OOF>OOE>OOC. The results revealed that feeding cocoa podhusk-based layer's mash considerably improved egg quality of laying hens.

Key Words: Comparison, Cocoa feed, Farmers' feeds, Egg quality, Laying hens

M16 Hemolytic and antimicrobial activity of guar meal extracts. S. M. Hassan*[1], O. Gutierrez[1], A. Haq[1], J. A. Byrd[2], C. A. Bailey[1], and A. L. Cartwright[1], [1]*Texas A&M University*, *College Station*, [2]*USDA-ARS Food and Feed Safety Research Unit*, *College Station, TX*.

Saponins extracted from guar meal were evaluated for hemolytic and antimicrobial activities. Saponin rich extracts were prepared by refluxing approximately 25 g guar meal with 250 mL ethanol:H_2O (1:1) for 3 hr, filtering and distilling the ethanol using roto-evaporation at 50 C. Resulting aqueous fractions were partitioned three times with equal volumes of n-butanol to yield saponin rich fractions of 4.8±0.6% of the original material. Ethanol extracted n-butanol fractions were further purified by reversed phase flash column chromatography on a C-18 preparatory column eluting 2 fractions with 20, and 1 each with 60, and 100% methanol (MeOH). Fractions were collected, roto-evaporated and freeze-dried with yields averaging 1.72±0.47, 0.88±0.16, 0.91±0.16 and 1.55±0.15 % of the original material, respectively. Freeze dried fractions were dissolved in PBS and filtered using 0.2 micrometer filters before use in two 96-well plate assays for hemolytic and antimicrobial activities. The hemolytic assay measured blood cell lysis of serial dilutions of the extracts (66.66 to 0.52 µgram/mL) using negative and 100% lysis control wells. Antimicrobial activity was measured as minimum inhibitory concentration (MIC) using serial dilution of the extracts (1 mg to 7.8 µgram extract/mL) in 96-well plates with negative and ampicillin or novobicin positive controls. A gram positive bacterium (Staphylococcus aureus) and two gram negative bacteria (*E. coli* and *Salmonella* Typhimurium) were surveyed. Hemolytic activity was observed in 100 % MeOH guar fractions (P<0.05) but not in 20 or 60% fractions. Antimicrobial activity was detected upon exposure of 100% MeOH fractions to Staphylococcus aureus but not to E. coli and *Salmonella* Typhimurium. Positive correlation of hemolytic and antimicrobial activity was only observed with 100% MeOH extracts and Staphylococcus aureus.

Key Words: Saponin, Guar meal, Hemolysis, Antimicrobial

M17 Evaluation of pearl millet in combination with different levels of flaxseed and natural pigment in laying hen diets. K. Amini* and C. Ruiz-Feria, *McGill University*, *Ste-Anne-de-Bellevue,QC, Canada*.

Two experiments were carried out to evaluate the effects of Canadian Pearl Millet (PM) in combination with different levels of flaxseed (FS) and natural pigment (Oro glo 15) on egg fatty acid(FA) profile and laying performance. In a six week experiment, six treatments were used (8 cage replicates, 3 birds per cage): a control diet (corn-soybean meal based diet) and diets in which corn was totally replaced by PM and supplemented with 0, 2, 4, 8 and 12% FS. In a 12 wk experiment, six diet treatments were used (6 cage replicates, 3 birds per cage) with diets based on PM with three inclusion levels of FS (4%, 6% and 8%) and two levels of natural pigment (0.1% and 0.2%). The diets were formulated to be isocaloric and isonitrogenous and to meet NRC requirements. Three eggs were randomly collected from each cage by the end of each week. Body weight, feed consumption, and egg production were recorded weekly. Yolk pigmentation was determined using the Roche® color fan. At the end of the experiments, all the hens were euthanized to determine liver integrity. Data were analyzed by one-way analyses of variance using the general linear models procedure of SAS. Egg characteristics and flock performance parameters were not different among treatments in both experiments. Yolk pigmentation score was lower for the diets containing PM compared with the control diet, but 0.1% inclusion of pigment was enough to restore pigmentation. No difference was observed among diets in regard to liver hemorrhage. We found that hens fed a diet based on pearl millet and 8% FS produced eggs with an average n-3 FA content of 447 mg , which was higher than n-3 FA content of eggs from hens consuming the control diet, or the PM based diets with lower FS supplementation. Diets based on PM and 8% FS can be used to produce n-3 FA enriched eggs, while maintaining flock productivity and health.

Key Words: Laying hens, Pearl millet, Flaxseed, Natural pigment, Flock performance

M18 Evaluation of Louisiana-produced extruded-expelled soybean meal for chickens. S. Powell[1], V. Naranjo[1], D. Lauzon*[1], L. Southern[1], T. Bidner[1], and C. Parsons[2], [1]*Louisiana State University Agricultural Center*, *Baton Rouge*, [2]*University of Illinois*, *Urbana*.

Soybean meal (SBM) can be produced either by solvent extraction or expeller-extrusion. Expeller-extruded SBM (EE-SBM) contains more oil but less CP than solvent extracted SBM (SE-SBM). The purpose of this research project was to evaluate the energy and protein content of EE-SBM compared with SE-SBM. True digestibility of the amino acids in EE-SBM was determined using the precision-fed cecectomized rooster assay (values are combined samples from 4 roosters). Digestibility values for the amino acids are as follows: Lys 86.8%, Met 87.4%, Cys 81.5%, Arg 92.2%, Thr 83.5%, Val 85.5%, Ile 86.5%, Leu 86.7%, His 86.4%, and Phe 88.9%. A growth experiment was conducted to evaluate the energy and protein content of the SBM. Ross x Ross 708 broilers (0 to 18 d of age) were used in 3 identical trials. Chicks were housed in starter batteries. Each trial had 8 replicates with 6 chicks per pen for a total of 24 replicates per treatment. Dietary treatments were: Diets 1 and 2) Corn-SE-SBM or corn-EE-SBM at 1% total dietary Lys and an ME of 3,300; Diets 3 and 4) Corn-SE-SBM or corn-EE-SBM at 1.3 % total dietary Lys and a ME of 3,000 kcal/kg; and Diets 5 and 6) Corn-SE-SBM or corn-EE-SBM at 1.3% Lys and a ME of 3,300 kcal/kg. The data will be presented and analyzed as 2 2x2 factorially arranged sets of treatments (one analysis will evaluate SBM source by Lys level and the second will evaluate SBM source by ME level). In the Lys component, daily gain (ADG), daily feed intake (ADFI), and gain:feed (GF) were decreased ($P < 0.04$) by the reduced Lys level but not affected ($P > 0.10$) by SBM source or the source by Lys level interaction. In the ME component, ADG and GF were

decreased and ADFI increased ($P < 0.01$) by the reduced ME level. Also, ADG and ADFI were decreased ($P < 0.06$) by EE-SBM, but there was no interaction ($P > 0.10$). The results of these experiments indicate that EE-SBM has similar feeding value to SE-SBM when the differences in nutrient values are considered in diet formulation.

Key Words: Broiler, Soybean meal, Extruded

M19 Intestinal enzymes gene expression of late term turkey embryos. J. E. de Oliveira*[1], P. R. Ferket[1], C. M. Ashwell[1], and Z. Uni[2], [1]*North Carolina State University*, *Raleigh*, [2]*Hebrew University of Jerusalem*, *Rehovot, Israel*.

The developing poultry embryo must go through an adaptive process of switching from lipid-based metabolism, associated with fat, absorbed by the yolk sac membrane, to a carbohydrate-based metabolism, associated with intestinal digestion and absorption. The intestine must develop sufficiently to receive exogenous substrates by the time of hatching. However, turkey poults have a limited ability to digest feed containing carbohydrates (CHO) and protein at hatch and they are susceptible to malabsorption problems of early survival. The objective was to study enteric development prior to hatch by measuring the sequence of gene expression of intestinal enzymes and nutrient transporters using microarray technology. Twenty-five Nicholas turkey eggs were sampled at 20, 22, 24, 26 and 28 d of incubation (E) to collect duodenum for RNA extraction. Fluorescent dyes were incorporated to cDNA produced from the extracted RNA and hybridized on array printed with 90 different 70 bp oligonucleotides. The intestinal genes studied were maltase/glucoamylase (MG), sucrase/isomaltase (SI), aminopeptidase (AP), peptide transporter 1 (PepT1) and sodium/glucose transporter 1 (GLUT-1). Cluster analysis revealed MG and SI mRNA was first expressed at E24, while PepT1 gene was expressed only at E28. Gene expression of AP was specifically evident at E22 and again at E26. GLUT-1 gene expression decreased from E20 until E26 and then was up regulated at E28. Enzymes and transporters responded to presence of substrate (amnion) until E26, but were independently highly expressed at hatch (E28) as in preparation for feeding.

Key Words: Turkey, Turkey embryo, Intestinal enzymes, Microarrays, Gene expression

M20 Effects of vitamin U on broiler performance and intestinal tract integrity. A. L. Shaw*, K. S. Macklin, and J. P. Blake, *Auburn University*, *Auburn, AL*.

Vitamin U (DL-methionine methylsulfonium chloride) has been found to modulate the immune system and protect the intestinal membrane in humans and swine. It has also improved weight gain and feed efficiency in cattle and hogs. Two trials were conducted to determine the effects of Vitamin U on growth performance, feed efficiency, and gut integrity of broilers. For each trial, day-old commercial broiler chicks were randomly allotted to one of 6 dietary treatments with 8 replicate pens each. Both trials employed a corn-soy starter diet from 0-28 d (21.5% CP, 3142 kcal/kg) and a grower diet from 28-42 d (19.5% CP, 3153 kcal/kg).

In Trial 1, 480 chicks (10 birds/pen) were fed the basal diet with 0, 200, 400, 600, 800, or 1000 ppm of Vitamin U. Birds were challenged with 1 ml of *Salmonella* Kentucky (10^6 cfu/ml) via oral gavage on day of placement and then re-dosed on day 14. Cecal samples of 4 birds/trt were collected and enriched weekly from days 7 to 28 to determine presence of *Salmonella*. Bird and feed weights were obtained on days 0, 7, 14, 21, 28, and 42. There was no effect on growth or feed efficiency due to Vitamin U addition. Significant differences ($p<0.05$) were present among the treatment levels for villi length, villi width, and crypt depth of the duodenum, jejunum, and ileum obtained on day 21.

In Trial 2, 384 chicks (8 birds/pen) were fed the basal diet with Vitamin U substituted for DL-methionine on a molecular weight equivalent at a rate of 0, 20, 40, 60, 80, or 100%. Feed and bird weights were obtained bi-weekly through 42 days of age. Vitamin U caused a slight decrease ($p<0.05$) in body weight gain between 0 and 14 days, with no differences detected in performance thereafter.

Vitamin U was not effective in improving growth or feed performance when fed to broilers challenged with *Salmonella*, nor did it provide advantages in performance as a substitute for DL-methionine. It did have an effect on duodenal villi characteristics, which may suggest an ability to aid in intestinal integrity improvement.

Key Words: Vitamin U, DL-methionine, *Salmonella* Kentucky, Broilers

M21 Response of broiler chickens to supplementation of xylanase or phytase in wheat-based diet. O. A. Olukosi* and O. Adeola, *Purdue University*, *West Lafayette, IN*.

Three-hundred broiler chicks were used for a 21-d study of growth response, bone ash, digestibility and carcass energy retention as influenced by supplementation of phytase or xylanase alone or in combination. Carcass retained energy was determined by comparative-slaughter. At day old, 20 broiler chicks were asphyxiated and frozen for determination of initial body energy content of the chicks. Two-hundred eighty chicks were assigned at 1-d old to 5 dietary treatments in a randomized complete block design. The treatments were: positive control (PC), negative control (NC) diet marginally deficient in ME and P, NC + phytase added at 1,000 FTU/kg, NC + xylanase added at 4,000 U/kg, and NC + phytase and xylanase added at the rates indicated above. Each treatment had 8 replicate cages of 7 birds each. Growth performance and feed intake data were collected weekly. On d 21, 1 bird with body weight closest to the average for the replicate cage was used for final body energy content determination. Excreta were collected at d 18 to 21 for determination of ME and total tract retention. Tibia was defatted and ashed for determination of bone ash. Phytase alone ($P < 0.01$) or in combination with xylanase ($P < 0.05$) improved final body weight of the broiler chicks whereas xylanase alone did. The treatments had no effect on either feed intake or gain:feed. Bone ash was not different between PC and NC; phytase alone or in combination with xylanase improved ($P < 0.01$) bone ash. Xylanase alone improved ileal digestible energy ($P < 0.01$). Combination of phytase and xylanase improved total tract DM retention ($P < 0.01$). Phytase alone or in combination with xylanase improved ($P < 0.01$) ME. Supplementation with phytase alone improved P retention ($P < 0.05$). Body retained energy was improved ($P < 0.01$) in the presence of phytase alone. In conclusion, supplementation of wheat-based diet with combination of phytase and xylanase improved growth performance of broiler chickens up to 21 d, however phytase by itself improved most of the response criteria whereas xylanase when used alone did not.

Key Words: Broilers, Performance, Phytase, Xylanase, Wheat

M22 Effect of dietary organic acids on phytate phosphorus disappearance. A. Liem*, H. M. Edwards, Jr., and G. M. Pesti, *University of Georgia*, *Athens*.

Supplementation of some organic acids to a phosphorus deficient diet has been shown to improve bone ash content in broilers. Two experiments were conducted from 0 to 16 d in battery pens to determine the effect of various organic acids supplementation on phytate P utilization, indicated by bone ash data, and phytate P disappearance. In both experiments, birds were fed a P deficient, corn and soybean meal based diet. In Expt. 1, citric acid, malic acid, fumaric acid, and ethylenediaminetetraacetic acid (EDTA) were supplemented at 3.23, 2.90, 2.90, and 3.65 % respectively. In Expt. 2, a 2 x 2 factorial design was utilized. Two sources of methinonine, 2-hydroxy-4methylthio butanoic acid (HMB), an organic acid, and DL-methionine (DLM) were added at 0.20% to the diets, with or without 500 U of phytase / kg diet. In Expt. 1, the addition of citric, malic and fumaric acid increased percent bone ash, but only the effect of citric acid was significant ($p<0.05$). The addition of citric acid and malic acid also increased the disappearance of P and phytate P ($p<0.05$). In Expt. 2, the addition of phytase to the diet significantly increased 16 d body weight gain, feed intake, percent bone ash, mg bone ash, phytate P disappearance, and decreased the incidence of P rickets. Methionine source did not affect 16d body weight gain, feed intake, feed efficiency, mg bone ash, and P rickets incidence. However, the birds fed HMB had higher percent bone ash and phytate P disappearance compared to birds fed DLM. The percent bone ash for the following treatments: DLM, HMB, DLM + phytase, and HMB + phytase were 28.5, 29.0, 31.2, and 33.2 %, respectively. The phytate P disappearance for the treatments above are 36.7, 39.5, 51.0, and 59.9%, respectively. With added phytase, HMB-fed chicks had higher percent bone ash and phytate P disappearance ($p= .005$ and $p= .026$ respectively), but not without added phytase ($p=.390$ and $p= .463$, respectively). In conclusion, some organic acids in our experiment, citric acid, malic acid and HMB, improved phytate P utilization, indicated by bone ash and phytate P disappearance data. HMB and phytase improves phytate P utilization by broiler chicks.

Key Words: Phytate, Phosphorus, Methionine, Broiler, Organic acid

M23 Effect of incremental levels of L-Lysine•HCl in low crude protein corn-soybean meal diets on growth performance of broiler chicks. A. Waguespack*, S. Powell, T. Bidner, and L. Southern, *Louisiana State University Agricultural Center*, *Baton Rouge*.

Three experiments (Exp.) were conducted to determine the level of L-Lys that can be included in corn-soybean meal (C-SBM) diets for broilers without an amino acid (AA) other than Met, Lys, Thr, or Gly becoming limiting. Ross x Ross 708 broilers (0 to 18 d of age) were used in brooder batteries. Treatments contained 7 or 8 replicates with 6 birds per pen. In all Exp., a control C-SBM diet containing no L-Lys•HCl was used. Also, a similar diet (PC+Gly) with supplemental Gly was fed to provide a total dietary Gly + Ser level of 2.32%, a level which previously has been shown to maximize growth performance of broilers fed AA-supplemented low CP diets. All diets were formulated to contain 1.26% total Lys and to maintain a ratio of TSAA:Lys of 0.72 and Thr:Lys of 0.70. Diets with added L-Lys•HCl contained supplemental Gly to provide a total dietary level of Gly + Ser of 2.32%. Also, when Lys was added, the dietary CP content was decreased by changing the ratio of corn to soybean meal. In Exp. 1, L-Lys•HCl was added to the diets at 0.02% increments from 0.15 to 0.27%. Compared with the PC+Gly diet, gain (ADG), feed intake (ADFI), and gain:feed (GF) were not affected ($P > 0.10$) by Lys addition to the diet. In Exp. 2, L-Lys•HCl was added to the diets at 0.05% increments from 0.25 to 0.60%. Compared with the PC+Gly diet, ADG and GF were decreased ($P < 0.03$) in diets containing greater than 0.30% L-Lys•HCl, but not ($P > 0.05$) in the diet containing 0.25% L-Lys•HCl. In Exp. 3, L-Lys•HCl was added to the diets at 0.05% increments from 0.20 to 0.30%. Daily gain was decreased ($P < 0.02$) in broilers fed 0.30% L-Lys•HCl but not in those fed 0.20 or 0.25% L-Lys•HCl. Feed intake and GF were not affected by L-Lys•HCl. The results of these Exp. indicate that 0.25% L-Lys•HCl (which results in a dietary CP level of 19.7%) can be added to C-SBM diets supplemented with Met, Thr, and Gly with no negative effects on growth performance, and that at 0.30% added L-Lys•HCl an AA other than these 4 becomes limiting.

Key Words: Broiler, Amino acid, Growth, Low crude protein

M24 Determination of the limiting amino acid other than methionine, threonine, lysine, and glycine in low crude protein corn-soybean meal diets for broiler chicks. A. Waguespack*, S. Powell, T. Bidner, and L. Southern, *Louisiana State University Agricultural Center*, *Baton Rouge*.

Two experiments (Exp.) were conducted to determine the order of limiting amino acids (AA) in low CP corn-soybean meal (C-SBM) diets for Ross x Ross 708 broilers (0 to 18 d of age) in brooder batteries. Treatments contained 7 or 8 replicates with 6 birds per pen. In both Exp., a control C-SBM diet (PC) and a similar diet (PC+Gly) with added Gly to provide a total dietary Gly + Ser level of 2.32% was fed. All diets in both Exp. were formulated to contain 1.26% total Lys and to maintain a ratio of TSAA:Lys of 0.72 and Thr:Lys of 0.70. In Exp. 1, the order of limiting AA was determined in a C-SBM diet containing 0.45% L-Lys•HCl and 17.8% CP. In addition to the PC and PC+Gly treatments, the treatments consisted of a negative control (NC), NC + 0.247% Ile, NC + 0.484% Arg•HCl, NC + 0.249% Val, and all possible two and three-way combinations of all 3 AA. Diets with added AA and the NC diet contained supplemental Gly to provide a total dietary level of Gly + Ser of 2.32%. Compared to the NC diet, addition of L-Arg•HCl and the combination of L-Arg•HCl and the other AA increased daily gain (ADG) and feed intake (ADFI) but not gain:feed (GF), indicating that Arg was the limiting AA in this diet. It is possible that the order of limiting AA (other than Thr, Lys, Met, and Gly) changes in a diet with different levels of supplemental Lys because of the change in ratio of corn to soybean meal. Therefore, Exp. 2 was conducted in an identical manner to Exp. 1 except the diets with the added AA contained the same ratio of corn to SBM that is found in a diet with 0.25% L-Lys•HCl, which was achieved by dilution with cornstarch. The results of Exp. 2 suggest that Arg and Val are equaling limiting in a diet with 0.25% L-Lys•HCl. In the diet with all 3 AA, ADG and ADFI were different ($P < 0.10$) from the PC and PC+Gly diet but GF was not different ($P > 0.10$). These results suggest that Arg and Val are equaling limiting (after Met, Thr, Lys, and Gly) in a diet containing 0.25% L-Lys•HCl.

Key Words: Broiler, Glycine, Low crude protein

M25 Dietary methionine sources affect intestinal microbial growth in broiler chickens. J. P. Dahiya*[1], D. Hoehler[2], A. G. Van Kessel[1], and M. D. Drew[1], [1]*University of Saskatchewan*, *Saskatoon SK, Canada*, [2]*Degussa Corporation*, *Kennesaw, GA*.

Previous work in our laboratory showed that methionine hydroxy-analogue (MHA-FA) is more available to gut bacteria than DL-methionine (DL-Met) and may stimulate the growth of intestinal bacterial populations including *C. perfringens*. An experiment was conducted to study the effect of various levels of DL-Met or MHA-FA on *C. perfringens* and other intestinal bacteria in broiler chickens. Two cages of 6 birds (14 d post-hatch) were assigned to one of 7 different diets containing no added Met (control); 2.0, 4.0 or 8.0 g/kg DL-Met or 2.27, 4.54 and 9.08 g/kg MHA-FA, thus providing 3 equimolar levels (0.2, 0.4 and 0.8%) of each methionine source. Birds were challenged with *C. perfringens* type A on d 1 and d 14 to 20, and killed on d 28. Intestinal populations of *C. perfringens*, lactobacilli, *Streptococcus* D and coli forms were enumerated and necrotic enteritis lesions were scored. There were no significant differences in the growth of various bacterial species in intestinal tract of broiler chickens fed two different methionine sources. However, we observed significantly reduced ($P < 0.05$) *C. perfringens* populations in ileum and cecum of birds fed 8 g/kg DL-Met and 9.08 g/kg MHA-FA supplemented diets vs. control. Also there was a significant interaction ($P < 0.05$) between methionine source and level for *C. perfringens* growth. The coli forms and *Streptococcus* D in ileum were significantly lower ($P < 0.05$) whereas lactobacilli in ceca were significantly higher in birds given highest levels of either DL-Met or MHA-FA than the other dietary treatments. There were no significant differences in necrotic enteritis intestinal lesion scores and performance of birds fed different methionine sources or concentrations. The results suggest that the use of low protein diets supplemented with relatively high levels of synthetic amino acids may reduce the risk of clostridial enteritis in broiler chickens.

Key Words: Methionine sources, Necrotic enteritis, Broiler chickens

M26 Standardized ileal amino acid digestibility of plant source ingredients in broiler chicks and turkey poults using a nitrogen-free or casein diet. S. A. Adedokun*[1], C. M. Parsons[2], M. S. Lilburn[3], O. Adeola[1], and T. J. Applegate[1], [1]*Purdue University*, *West Lafayette, IN*, [2]*University of Illinois*, *Urbana/Champaign*, [3]*The Ohio State University/OARDC*, *Wooster*.

The aim of this study was to determine the apparent and standardized ileal amino acid digestibility (SIAAD), total amino acid (TAA), and N digestibility of 5 feed ingredients in 5- and 21-d old broiler chicks and turkey poults. Two methods of endogenous standardization were used, a nitrogen-free diet (NFD) and a completely digestible protein (CDP, 10% casein). The feed ingredients were two samples of corn distillers′ dried grains with solubles (light, L and dark, D DDGS), canola meal, corn, and soybean meal. These ingredients were the sole source of amino acids in the diets (20% CP). Each diet was fed to six replicates pens containing 30 and 8 birds which were sampled on d 5 and d 21, respectively. Age had a significant effect on apparent ileal amino acid and N digestibility in broilers. Both standardization methods in chicks resulted in higher values relative to the apparent digestibility values. Standardization using CDP in chicks resulted in higher ($P < 0.05$) standardized ileal digestibility for TAA, N, and some of the amino acids on d 21 for L DDGS, canola meal, corn, and SBM relative to the NFD method. The effect of poult age on ileal amino acid digestibility was significant for L DDGS, corn, and SBM. In poults, both standardization methods resulted in higher SIAAD compared to apparent digestibility, however, there was no significant difference in SIAAD values between the two methods at any particular age except for corn where SIAAD on d 21 was higher ($P < 0.05$) using a NFD method. Both the apparent and SIAAD values were higher for the L DDGS than the D DDGS in both species. The SIAAD for canola meal, corn, and SBM were higher than for DDGS in both species on d 5. These results show that correcting for ileal endogenous amino acid resulted in higher digestibility values and both methods of standardization produced similar results in poults at d 5 and d 21 whereas SIAAD in broiler chicks was higher on d 21 (3.8% TAA) using a CDP method.

Key Words: Casein, Chick, Ileal endogenous amino acid, Poult, Standardized ileal amino acid digestibility

M27 Utilization of low protein diets by large high yield Ross-708 broilers. J. Small*[1], E. O. Oviedo-Rondón[1], P. Tillman[3], D. Hoëhler[4], J. Grimes[1], C. M. Ashwell[1], and S. Shah[2], [1]*North Carolina State University*, *Raleigh*, [2]*North Carolina State University*, *Raleigh*, [3]*Ajinomoto Heartland Lysine*, *Chicago, IL*, [4]*Degussa Corporation*, *Kennesaw, GA*.

The US broiler industry currently has a tendency to grow large, high yield broilers. Commercial broiler diets are formulated to guarantee that these flocks receive all amino acids (AA) needed for high meat yield. Historically, relatively high protein diets (HP) have been used. In contrast, environmental regulations for nitrogen and ammonia are becoming more stringent. Low protein diets (LP) with AA supplementation are the logical alternative to reduce N waste. This project aimed to evaluate the effects of LP on high yield Ross-708 broilers raised to 56 d on live performance, carcass traits, flock uniformity, body chemical composition and blood metabolites. 240 day-old chicks of each sex were individually tagged and placed in 16 floor pens of 30 birds. Diets were formulated to contain equal amounts of digestible AA by adding crystalline Lys, Met, and Thr. Crude protein levels were 21 or 24% for starter (1-14 d), 20 or 23% for grower (15-34 d), 18 or 21% for finisher (35-56d) for LP and HP diets, respectively. Blood was drawn at 35 d from one male chicken per pen. Three birds of each gender from each pen (24/trt/sex) were processed at 56 d to determine carcass and parts yield. A 2X2 factorial design was used for data analyses. Final average body weights for males were 4292 and 4340 g, and females were 3366 and 3379 g when fed LP and HP diets, respectively. Gender differences were apparent for all variables evaluated. No significant differences ($P>0.05$) due to diets were observed for body weight, feed intake, or feed conversion in any feeding period or for the entire grow out. Flock uniformity as coefficient of variance was 6.7 and 7.1% for males, and 8.3 and 5.7% for females fed LP and HP diets, respectively. No significant differences ($P>0.05$) were observed for dressing, individual parts, abdominal fat or organ percentages. Body chemical composition was affected ($P<0.01$) by diet treatment in males only. Blood level of Val, Leu, Ile, and HyPro were lower in male chickens fed LP. In conclusion, LP diets supplemented with crystalline AA did not affect performance or meat yield of large broilers while N efficiency was increased.

Key Words: Large broilers, Low protein diets, Amino acids, Meat yield, Body composition

M28 Reducing dietary crude protein while maintaining performance and improving economics in Ross 708 broilers. E. A. Guaiume*[1], J. D. Firman[1], D. Hoehler[2], P. B. Tillman[3], D.

Burnham[4], J. Parcell[1], L. B. Linares[1], and P. Butkeraitis[1], [1]*University of Missouri*, *Columbia*, [2]*Degussa Corporation*, *Kennesaw, GA*, [3]*Ajinomoto Heartland LLC*, *Chicago, IL*, [4]*Aviagen Inc.*, *Huntsville, AL*.

A study was conducted to determine the effects of reduced dietary crude protein (CP) on performance and economics of Ross708 broilers from hatch to week 8. 1440 straight-run broiler chicks were randomly assigned to 4 treatments with 12 replicate pens containing 30 birds each. Diets were formulated to be isocaloric and to have the minimum digestible level for lysine , and the same minimum ideal amino acid ratios to lysine for Met+Cys, threonine, valine, isoleucine, arginine, and tryptophan across the four phases [starter (0-2wks), grower (2-4wks), finisher (4-6½wks), and withdraw (6½-8wks)]. An industry standard diet served as the control (A) and the benchmark for performance. The remainder of the treatments (A-0.5%, A-1.0%, and A-1.5%) had CP reduced in 0.5% increments. Birds were weighed at 2, 4, 6½, and 8 weeks of age for feed to gain calculation. At week 8, 4 birds per pen (48/trt) were sacrificed and had fat pad and carcass weighed, and carcass and meat yield determined. Feed cost savings (FCS) per metric ton (MT) of live body weight (BW), FCS/MT carcass, FCS/MT breast meat, income over feed cost/MT carcass, and income over feed cost/MT breast meat, were calculated. Treatments had no effect (P>.05) on performance throughout the 8-week period. At week 8, birds fed A-1.5% had a higher (P<.05) percentage of fat pad when compared to A (3.11% versus 2.77%, respectively for A-1.5% and A). The remainder of the treatments did not differ from the control. In addition, treatments had no effect (P>.05) on carcass and breast meat yield at 8 weeks of age (A: 33.82%; A-0.5%: 33.37%; A-1.0%: 33.13%; A-1.5%: 33.08%). For BW, relative to A, FCS were $3.90/MT when A-1.5% was fed; for carcass, $5.46/MT; and for breast meat, $16.37. Therefore, birds fed A-1.5% CP resulted in an increased income over feed costs of $5.46/MT carcass and $16.37/MT breast when compared to A. Overall, these results suggest that a decrease of CP by 1.5%, as compared with industry standards, did not affect performance, carcass, and meat yield, and resulted in significantly higher revenues.

Key Words: Low crude protein, Broilers, Performance, Meat yield, Economics

M29 Nutritional value of yeast extract Nupro® in male broiler chicks and turkey poults. R. L. Nanney*[1], P. R. Ferket[1], A. A. Santos Jr.[1], E. O. Oviedo[1], J. L. Grimes[1], and C. Parsons[2], [1]*North Carolina State University*, *Raleigh*, [2]*University of Illinois*, *Champaign*.

Yeast extract is a potentially valuable nutrient source of amino acids, peptides, nucleotides, vitamins, minerals and inositol for neonatal poultry, but feeding value must be estimated to facilitate least-cost feed formulation. Our objective was to determine metabolizable energy (ME) and true amino acid digestibility (TAAD) of the yeast extract Nupro® (NP, Alltech, KY). In experiment 1, true Me (TME) and TAAD of NP were determined in cecectomized roosters by precision feeding method. In experiments 2 and 3, 6 replicate groups of 15 male chicks and poults were fed diets containing 0, 5, 10 and 15% NP at the expense of a corn-soy diet that met NRC recommendations for 1-21d. Body weight (BW) and feed/gain (FCR) was determined at 7, 14, 21d and AMEn was determined from fecal collections from 12-14 and 19-21d. Average TAAD and TME of NP were determined to be 86.79% and 3,611 kcal/kg DM, respectively, which agree with the AME values determined for both trials. The chicks fed the 5 and 15% NP in the diet had heavier BW than those fed 0 and 10% NP throughout the trial (21d BW: 938, 932 vs 900, 891g, respectively, P<.05). Likewise, 1-21d FCR of chicks fed 5 and 15% NP was better than those fed 0 and 10% NP (1.264 and 1.262 vs 1.306 and 1.326, respectively, P<.05). Poults fed 10 and 15% NP had significantly greater 21d BW than those fed 0 and 5% NP (634 and 609 vs 498 and 567g, respectively, P<.05). However, 1-21d FCR was better for poults fed 0 and 5% NP than those fed 10 and 15% NP (1.160 and 1.199 vs 1.257 and 1.255, respectively, P<.05). Mortality rate was not significantly affected by dietary treatment in either experiment. The effect of dietary NP supplementation on the performance appears to be dependent upon the dose and species. Nupro® can be fed as high as 15% of the diet without adverse effects on feed intake and BW; however the benefit of NP may differ in chicks and poults.

Key Words: Nucleotide, Chicks, Poults, Performance, TME

Monday, January 22
Environment and Management I
Room: B314

M30 Utilization of cocoa pod husk (CPH) as substitute for maize in layers mash and poultry farmers' perception in Nigeria. E. O. Uwagboe*[1], R. A Hamzat[1], and M. Olumide[2], [1]*Cocoa Research Institute of Nigeria*, *Ibadan, Oyo State, Nigeria*, [2]*Kolmart Farms*, *Ibadan, Oyo State, Nigeria*.

Developing processing technique for efficient use of crop by–products such as cocoa pod husk (CPH) is very important in order to promote poultry feeding in the rural communities in Nigeria. Oluyole and Egbeda Local Government Areas (LGAs) of Oyo state, Nigeria were purposively selected out of the nineteen L.G.As producing cocoa in the state while one hundred and twenty respondents were selected from the list of eight hundred registered poultry farmers with simple random sampling technique. The farmers used the Cocoa Pod Husk (CPH) for a period of eight weeks January through February 2006 after which they were interviewed with interview guide. The data were presented using frequencies, percentages and charts while chi–square was used for the analysis.

The result revealed that 85 percent of the farmers are educated and 95 percent were willing to use CPH in feed production for layers. The result also revealed that there is a significant relationship between constraints of inadequate energy source of ingredients(X^2=6•242, p≤0•05) method of processing (X^2=5•895, p≤0•05), inadequate labour (X^2=9•196, p≤0•05) and perception of poultry farmers towards use of Cocoa pod husk as substitute for maize in layers mash. Five Points Likert Scale result revealed that 85 percent of the respondents had positive perception towards the use of CPH as substitute for maize in layers mash and 75 percent had negative perception towards the processing method of CPH.

In conclusion, poultry farmers are willing to use CPH as a substitute for maize in layers mash if there is an improved method of processing. Hence, there is need for modern processing technique of CPH using hygienic method and at commercial level to enhance increase in the use of waste cocoa by-products and reduction in feed production cost in Nigeria.

Key Words: Cocoa pod husk, Processing, Utilization, Farmers, Perception

M31 Isolation and evaluation of *Salmonella*-lytic bacteriophages from commercial broiler houses. J. P. Higgins*[1], R. L. Andreatti Filho[2], S. E. Higgins[1], G. Gaona[1], S. N. Henderson[1], A. D. Wolfenden[1], G. Tellez[1], W.G. Bottje[1], and B. M. Hargis[1], [1]*University of Arkansas*, *Fayetteville*, [2]*College of Veterinary Medicine and Animal Science (FMVZ) Sao Paulo State University (UNESP)*, *Botucatu, SP, Brazil*.

Bacteriophages (Ø) represent a group of viruses that specifically infect and replicate in bacteria, and could potentially be used to reduce recovery of *Salmonella* (*S*) from poultry. For experiments 1 – 3 environmental drag swab samples were collected from 5 – 6 broiler houses, each located on different farms for isolation of *S* and Ø. In experiment 1, *S* was isolated from 3 of the 6 houses. Six drag swab samples were individually screened against a panel of 9 endemic *S* isolates of 5 serotypes and no Ø was isolated. In experiment 2, *S* was isolated from all 6 houses. Six drag swab samples were individually screened as above and Ø were isolated from 4 out of 6. Interestingly, none of the Ø isolated were able to initially lyse the *S* isolated from that same house. However, once the Ø were amplified in a different *S* host these Ø were then able to lyse the *S* that was isolated from the original source environment. In experiment 3, *S* was isolated from 3 of the 5 houses. Five drag swabs were individually screened against a panel of 12 endemic *S* isolates and Ø were isolated from 2 out of 5 houses. Again, none of the Ø isolated were able to initially infect the *S* isolated from the same environment. However, in experiment 3, none of the Ø were able to infect the *S* from the same house following amplification in an alternate *S* host. Based upon unique Ø host susceptibility profiles and plaque morphologies, at least 9 unique Ø isolates against *S* were identified. In all cases Ø were only isolated from houses positive for *S* with one exception in experiment 3. In summary, *S* Ø isolations were successful almost exclusively from poultry environments where *S* was also isolated. Interestingly, Ø from given environments were not able to lyse *S* recovered from those environments. Based upon these observations, the presence of Ø against S does not immediately explain the absence of S in some poultry environments.

Key Words: *Salmonella*, Bacteriophage, Poultry, Environment, Drag Swab

M32 Effect of broiler litter on growth of campylobacter. Z. T. Williams*[1], K. Christensen[2], M. Putsakum[1], Y. Vizzier-Thaxton[1], and S. W. Anderson[1], [1]*Mississippi State University*, *Mississippi State*, [2]*OK Foods, Inc.*, *Ft. Smith, AR*.

Campylobacter is one of the leading causes of food born illness in the United States with poultry frequently sited as a reservoir of the organism. While there are many possible sources of broiler flock contamination, litter has been implicated numerous times as not only a primary source of infection but as a mode of transmission between consecutive flocks.

This experiment was conducted to determine if the type of litter or specific characteristic of the litter such as pH or moisture content, could influence whether or not Campylobacter was able to colonize the litter and subsequently the birds .

Litter Samples were taken using a zig-zag pattern throughout the broiler house. The pattern insured that samples from under or near feeders and waterers as well as areas approaching the sides and ends of the house were represented. In addition to measuring pH and moisture content, each sample was cultured in Campylobacter enrichment broth and then inoculated onto 10 Campylobacter Cefex plates. After 48-hour incubation plates were examined for the presence of generic Campylobacter. The data indicates that litter condition and type does influence the colonization of Campylobacter.

Key Words: Litter, Campylobacter, Broilers

M33 Effect of organic acids and probiotics on *Salmonella enteritidis* (SE) infection in broiler chicks. A. D. Wolfenden*[1], R. L. Andreatti Filho[2], J. P. Higgins[1], S. E. Higgins[1], G. Goana[1], G. Tellez[1], and B. M. Hargis[1], [1]*University of Arkansas*, *Fayetteville*, [2]*Sao Paulo State University*, *Botucatu, SP. Brazil*.

A commercially-available (IVESCO LLC) water treatment PerforMax Optimizer II (PMO) and probiotic (FM-B11) have independently been reported to have anti-*Salmonella* effects. In exp. 1, 80 day-of-hatch chicks were challenged by oral gavage with 2.8 x 10^4 cfu SE, held in chick boxes for 2 h, and randomly assigned to either untreated control or continuous PMO treatment in the drinking water(dw; 1:128 product dilution for all exps.) in brooder batteries. Crop and cecal tonsils were cultured at 48 h and 5 d post-challenge for recovery of SE after enrichment. SE recovery in the crop and cecal tonsils at 48 h was significantly ($p<0.05$) lower in the PMO treated group as compared to control (crop: 75% vs 100%; cecal tonsil: 55% vs 100%, respectively) but not different at 5 d. In exps.2 and 3, 160 day-of-hatch chicks were SE challenged (2.4 x 10^4 cfu), held in chick boxes for 2 h, and randomly assigned to either untreated control, FM-B11 (1.8 x 10^7 cfu by oral gavage 1 h prior to placement), PMO, or FM-B11+PMO (n=40 per group). After 24 or 48 h in the brooder battery, crop and cecal tonsils were cultured for the presence or absence of SE recovery after enrichment. After 24 h, FM-B11 or FM-B11+PMO significantly ($p<0.05$) reduced SE recovery from the crop as compared to controls (75, 40 and 100%, respectively). All treatments reduced ($p<0.05$) SE recovery from the cecal tonsils at 24 h (control: 60%, FM-B11: 25%, PMO: 45%, FM-B11+PMO: 13%). While no significant differences were observed in SE recovery from crop at 48 h, SE recovery from FM-B11 and FM-B11+PMO groups was significantly lower than the controls in the cecal tonsils (20, 20 and 100%, respectively). In exp. 3, FM-B11 or FM-B11+PMO caused reduced cecal tonsil SE recovery as compared to controls at 24 h (5, 15 and 75%, respectively), and at 48 h (40, 21 and 100%, respectively) and FM-B11+PMO again reduced SE recovery incidence in crops at 48 h as compared to controls (42% vs 100%, respectively). These data suggest that combination treatment with FM-B11 and PMO are more effective than individual treatment for *Salmonella* reduction in chicks.

Key Words: *Salmonella*, Organic acids, Probiotic

M34 The effect of feed additive antimicrobials on antibiotic resistance activity of gram negative microbes indigenous to poultry. D. Cork[1], A. Gupta*[1], and J. Mathers[2], [1]*Illinois Institute of Technology*, *Chicago, IL*, [2]*Alpharma Animal Health*, *Chicago Heights, IL*.

Bacitracin, monesin, salinomycin, lasalocid and bambermycin are important feed additives used in the poultry industry due to their

antimicrobial activities and use as dietary production enhancers. The antimicrobial activity is generally limited to gram-positive, with minimal inhibition of gram-negative microorganisms. Initial studies have suggested resistance or plasmid loss effects in some bacterial classes. Six selected gram-negative poultry strains (3 *E.coli* & 3 *Salmonella typhimurium*) with phenotypic resistance to tetracycline and ampicillin (determined by antibiotic susceptibility testing) were screened for the presence of plasmid-borne tetR and ampR genes. Plasmid DNA profiling on agarose gel electrophoresis indicated sizes ranging from 3 to 50 kilobases in the selected strains. The plasmids were further evaluated for curing or decrease in copy number following *in vitro* exposure to various concentrations of the aforementioned feed additives. The compounds sodium dodecyl sulfate and acridine orange were additionally applied as known curing agents. Effective levels of some of these feed additive antimicrobials were found to affect losses or reductions of plasmids in certain strains. Plasmid band reductions in liquid test cultures were correlated with the percentage of isolates in the test system demonstrating phenotypic sensitivity to tetracycline and ampicillin. Such data may be important inputs in setting prudent standards for the use of feed additive antimicrobials in the poultry industry.

Key Words: Antimicrobials, Plasmids, Poultry, Microorganisms, Feed

M35 Performance comparison between the use and non-use of an enteric health antibiotic program in commercial broiler flocks. J. Bray*[1,2], T. Cherry[1], J. Carey[2], and C. Smith[1,2], [1]*Stephen F. Austin State University*, *Nacogdoches, TX*, [2]*Texas A&M University*, *College Station*.

In the US, current trends show that enteric health antibiotics are being removed from broiler diets. The use of these antibiotics in broiler production is a contentious issue. An experiment was conducted to compare the differences in performance parameters between broilers that were fed enteric health antibiotics in the diets and broilers that were not fed enteric health antibiotics in the diets. This is the preliminary report from three flocks of a five flock trial. Broilers were reared under commercial settings in solid-side wall, tunnel ventilated broilers houses. The four-house farm was divided into two separate farms with two houses being fed the enteric antibiotic program and the other two were fed a naïve feed. Initially, 27,600 broilers were placed per house and reared for 49 days. All birds were fed commercially produced starter, grower and withdrawal rations. Individual body weights of 100 birds per house were collected at 18, 35, and 49 days of age. Feed conversion and adjusted feed conversion were calculated for each these days. Coccidiosis lesion scores using the Johnson and Reid Method were collected at 14, 21, 28, 35, and 42 days of age. At the conclusion of each flock 140 birds from both treatments were selected and processed in a yield study. The nature of the differences in bird performance between the treatments varied from flock to flock. In general the data indicates a slight improvement in performance and gut health among flocks receiving antibiotics.

Key Words: Broilers, Antibiotics, Performance, Enteric

M36 Effects of water treatment products on broiler performance. J. G. Hughes*, J. M. Cornelison, A. G. Hancock, L. B. Davis, and S. E. Watkins, *University of Arkansas*, *Fayetteville*.

The poultry industry continues to search for ways to improve bird performance with water additives. Two water acidifiers Kem San®, a proprionic acid blend and SYNTRx, a proprietary acid blend and one sanitizer, PronTech™, a cationic salt, were evaluated for their impact on broiler performance. Each product was added to the water according to manufacturer's recommendations and given to 6 pens of 55 birds on a continuous basis. Plain tap water served as the control. Average pH for each treatment was 4.49, 2.73, and 7.65 respectively, with the control pH averaging 7.98. Birds were group weighed by pen at days 14, 28, 42, and individually weighed at day 49. Feed consumption was measured for each period. There were no significant differences in body weights, feed conversion or mortality throughout the trial. Average weights, in grams, for the control, Kem San®, SYNTRx and PronTech™ for days 14 and 49 were 358, 357, 367 and 379 and 3508, 3488, 3493, and 3556. The feed conversion for the control, Kem San®, SYNTRx and PronTech™ for day 14 were 1.219, 1.189, 1.180, and 1.224. Feed conversions for day 49 were 1.684, 1.675, 1.702, and 1.688.

Key Words: Water acidifiers, Water treatments, Broiler performance, pH

M37 Evaluation of different products used for cleaning drinking water systems. A. G. Hancock*, J. G. Hughes, and S. E. Watkins, *University of Arkansas*, *Fayetteville*.

Clean water systems are essential for providing good water quality to poultry. Several products were evaluated for their effectiveness as water sanitizers in water that had an abundance of algae growth. The different products evaluated were: Proxy-Clean™, CID 2000®, Pro-Clean which are all concentrated stabilized hydrogen peroxide products; 35 % hydrogen peroxide, Citric Acid, 6% Sodium hypochlorite or household bleach, and Poultry PronTech™ which is a cationic salt. Each product was added to 2- 50 ml aliquots of water and untreated water served as the control. The Proxy-Clean™ and 35 % hydrogen peroxide were added at a rate of three percent. The CID 2000® was added at a rate of 2 %. The citric acid was prepared in a stock solution of two packets per one gallon of water, and the stock solution then used at a rate of 1:128. The household bleach was added at a rate of one ounce of bleach per gallon of water or 0.78% concentration. Also a stock solution was prepared using twelve ounces of bleach per gallon of water; the stock was then metered at 1:128. The product Pro-Clean was added at the standard medicator rate of one ounce per gallon and also at a rate of three percent. Poultry PronTech™ was added at a rate of one gram per liter or 400 ppm, and also at a rate of one gram per four liters or a rate of 100 ppm. The aerobic bacteria loads along with yeast and mold counts were tested initially and four hours and twenty-four hours after treatment. The ORP and pH for each sample was tested.

Microbial loads prior to treatment were within a six log range. Four hours after treatment the product CID 2000® had the greatest reduction in microbial presence, with the household bleach at .78%, Proxy-Clean™, and Pro-Clean products at the 3% rate had the next lowest levels of microbial presence. The remainder of the products only showed a one log reduction in microbial presence.

Key Words: Water sanitation, Chlorine, Hydrogen peroxide

M38 Effect of ventilation, basket capacity, and machine temperature during the last 5 days of incubation on broiler hatching egg temperature and embryonic development. J. T. Brake, P. W Plumstead, K. E Brannon*, N. Leksrisompong, J. H Small, and E. O. Oviedo, *North Carolina State University*, *Raleigh*.

It was hypothesized that altering hatching basket ventilation and capacity would ameliorate the adverse effects of high egg temperatures on embryonic development and broiler performance. Ross 344 x 708 SF broiler eggs were incubated at an egg temperature of 37.2-37.8°C until E17 when eggs were distributed into four combinations of basket ventilation and basket capacity in either a ″Hot″machine (38.2°C) or a ″Cool″ machine (36.1°C). The normal ventilation treatment (CN) utilized standard hatching baskets. The top-taped (TT) treatment did not permit air to flow through the top of each basket. Low and high basket capacity comprised either 95 or 190 eggs per basket, respectively. There were two replicate baskets per combination per machine. Egg temperatures and basket exit air velocities were measured daily from E17 to hatching. At hatching, BW and relative weights of the yolk, heart, liver, proventriculus, gizzard, and small intestines were determined. In the Cool machine, a significantly larger BW, and yolk and heart weights were observed in the CN-190 interaction, as well as a significantly smaller liver. In the same Cool machine, the TT-190 interaction displayed a significantly reduced BW, and yolk and heart weights in addition to a significantly larger liver. However, in the Hot machine, significant differences between the interactions were apparently obscured by increased egg temperature. Chicks were grown to 21 d and BW, adjusted FCR, and mortality were determined. At 7, 14, and 21 d of age the largest BW was observed in the CN-Hot interaction while the lowest was observed in the TT-Hot interaction with no major differences observed for adjusted FCR. The most notable difference in mortality was for the main effect of capacity, where the 95 treatment gave 0% mortality while the 190 treatment gave 3.13%.

Key Words: Ventilation, Capacity, Machine temperature, Egg temperature, Embryonic development

M39 Embryonic development when eggs are turned different angles during incubation. H. R. Cutchin*, S. L. Funderburk, M. J. Wineland, V. L. Christensen, and K. M. Mann, *North Carolina State University*, *Raleigh*.

Failure to turn eggs during incubation has been demonstrated to cause improper development of extra embryonic components necessary for embryonic growth. These include reduced development of the area vasculosa (AV), chorioallantoic membrane (CAM), an increased amount of residual albumen (RA) and reduced volume of sub embryonic fluid (SEF). The purpose of this trial was to evaluate the effects of different turning angles upon development. Eggs stored for 1 day from 48 week old broiler breeder hens were used in three incubators set at 15°, 30° and 45° turning angles with 720 eggs per treatment. The profiles for each incubator were kept the same. At days 3, 6, 8, 13, 18 and 20 samples were collected and evaluated for various aspects of embryonic growth such as: size of AV, amount of SEF, embryo size (ES), CAM development and amount of RA. Eggs were weighed, volume was determined, and moisture loss was calculated at designated sampling times. Hatch of fertile was significantly different (45°>30°>15°). 15° angle demonstrated significantly reduced 6d SEF volume but not CAM or AV. At hatch the residual yolk sac was removed from 20 chicks per treatment and all dried down at 70°C for determination of moisture content. Hatched chicks from eggs turned 45° weighed significantly more and had less dry matter in the residual yolk. Examination of hatch residue demonstrated significantly greater pipped chicks as well as embryonic dead 4-10d and 17-21d in the group turned 15°. Additionally, these embryos exhibited increased malpositions, hemorrhages and residual albumen. Turning eggs 15° causes multiple embryonic maladies while reduced hatch was noted in eggs turned 15° and 30°.

Key Words: Turning, Incubation, Malposition, Sub embryonic fluid, Chorioallantoic membrane

M40 Influence of a twice a day versus once a day feeding program after photostimulation on the reproductive performance of broiler breeder hens. J. M. Spradley*, M. E. Freeman, J. L. Wilson, and A. J. Davis, *University of Georgia*, *Athens*.

Previously we reported that extending skip-a-day feeding past photostimulation until five percent egg production decreased total egg production by more than 15 eggs per broiler breeder hen through 65 weeks of age. Those results suggested that broiler breeder hens' reproductive performance was very sensitive to periods of food deprivation. Therefore in the current research the effect of feeding hens twice a day versus once a day after photostimulation on egg production was investigated. Pullets were reared using a skip a day feeding program from 2-21 weeks of age. All pullets were weighed at 20 weeks of age and then segregated into 30 laying pens (35 hens and 4 roosters per pen) such that each pen had a similar distribution of body weights. At 21 weeks of age 15 laying pens were placed on once a day feeding while the other 15 pens were placed on twice a day feeding. The total amount of feed provided per day to the laying pens was the same for both treatments, however, the once a day birds received all of their feed at 6:30AM, while the twice a day birds received 60% of their total feed allotment at 6:30 AM and the other 40% at 3:00PM. Although egg production commenced for both treatments at the end of 23 weeks of age, total egg production through 29 weeks of age is significantly greater for the birds provided feed twice a day. Weekly hen-day egg production was significantly greater for the hens fed twice a day for the entire period from 24 – 29 weeks of age. In addition, although the body weight profile for the two treatments was equal at the start of the experiment, the coefficient of variation for body weight was also significantly smaller for the twice a day fed hens at 29 weeks of age. The results provide further support that once pullets are photostimulated it is essential to limit fasting periods with regard to dietary intake for maximum egg production in broiler breeder hens.

Key Words: Broiler breeder hen, Twice a day feeding, Egg production

M41 Broiler breeder feeding program during rearing and early lay affects reproductive and progeny performance. N. Leksrisompong*, P. W Plumstead, H. Romero-Sanchez, K. E. Brannan, and J. Brake, *North Carolina State University*, *Raleigh*.

Twelve replicate pens of 190 females each were randomly assigned to two rearing feeding program treatments (sigmoid or line) from 1

to 21 wk of age and two feed increase treatments (slow or fast) from photostimulation to peak egg production in a 2 x 2 factorial design with three replicate pens each. The flock was photostimulated at 21 wk of age when Ross 344 males and Ross 308SF females were housed and mixed in the production facility. Females from the sigmoid rearing program weighed more at 4, 6, 8, 10, and 12 wk but less at 18, 40, 48, and 56 wk. There were no differences in rate of lay but females that had been reared on the sigmoid feeding program exhibited reduced mortality during the laying period that resulted in an increased number of eggs per hen housed. Fertility was not affected but fertile hatchability was improved by the sigmoid rearing program as well. No differences due to the two different feed increase programs were found other than that the slow program produced a heavier egg weight at 28 wk. Eggs produced by these hens at 28 wk were incubated under standard conditions and the carryover effects on the broiler progeny evaluated. Fifteen male and 15 female broiler chicks were randomly assigned across 72 pens to create a 2 x 2 x 2 design with 9 replicates per interaction cell with sex added as the third main effect. Body weight, feed consumption, adjusted feed conversion ratio, and mortality were measured to 42 d. Male broilers were heavier and exhibited higher mortality than females, as expected. Mortality was significantly affected by the broiler sex by breeder feed increase rate from photostimulation to peak egg production interaction in that male broilers from the slow feed increase program exhibited the highest mortality. This was thought to be due to an increased egg temperature in the larger eggs of the slow feed increase group that adversely affected embryonic development, specifically the heart.

Key Words: Broiler breeder, Broiler progeny, Feeding program

M42 Measurements of growth and sexual maturity of commercial broiler-breeder pullets fed on varying growth curves. R. S. Harper*[1], B. Harvey[1], D. E. Yoho[1], J. R. Moyle[1], P. Sbanotto[2], and R. K. Bramwell[1], [1]*University of Arkansas*, *Fayetteville*, [2]*Cobb-Vantress, Inc.*, *Siloam Springs, AR*.

Finding ways to measure pullet development and maturity is an important concept in the commercial broiler-breeder industry. Measurements are routinely taken to gather a sense of the uniformity of the flock. Body weight has long been the main measuring tool to check this uniformity. This study examines some new techniques in order to gauge pullet growth and sexual development. Cobb 500FF pullets were reared in four treatment groups, consisting of two separate growth curves. Two of the curves were a standard pullet growth curve and the other two a modified curve. The modified curve held the birds' growth back early in the rearing stage and then accelerated the growth towards lighting. Each curve had a high calorie feed treatment and low calorie feed treatment. Thirty birds from each treatment group were randomly selected for this trial. Measurements taken include: pelvic bone spread, body weight, fat pad score, fleshing score, comb and wattle development, and primary wing feather molt. Each bird was banded and measured to obtain the appropriate data previously mentioned. Birds were evaluated every two wks beginning at 12 wks and ending at 24 wks of age. At 20 wks the birds were moved from the pullet house into a production hen house. Data indicates that pullets that were gaining weight the fastest before being lit (modified curve) had the largest response to lighting. These birds had the largest increases in pelvic width and comb and wattle development. This data indicates that birds gaining aggressively before lighting at 21 wks are the most ready to become sexually mature and respond to light stimulation. Additionally, results of this experiment indicate that there are other factors besides body weight that can be utilized to assess a pullets readiness for their response to light stimulation.

Key Words: Pullet management,, Pullet sexual maturation,, Pullet development

M43 Evaluating external physical characteristics of commercial broiler breeder males and testes weight and volume. A. D. Swaffar*, D. E. Yoho, J. R. Moyle, R. S. Harper, and R. K. Bramwell, *University of Arkansas*, *Fayetteville*.

Commercial breeder managers often attempt to assess the reproductive potential of broiler breeder males by their physical characteristics. When evaluating the physical characteristics of commercially reared broiler breeder males the assumption is often that the more predominate the physical characteristics of the male, the larger the testes. This study was designed to determine if several physical characteristics had an effect on testicular weight and volume. Commercially raised broiler breeder males varying in age from 16-65 weeks of age were obtained from commercial broiler breeder farms and were brought to the University of Arkansas for evaluation. Males were weighed live, shank and spur length measured, the comb length, height and circumference determined, and wattle length was measured. Males were euthanized and the comb and wattles removed to obtain weights for each. The testes of each male were harvested and weighed in pairs with the weight and volume recorded for each male. Data were analyzed using JMP statistical software package. Paired testes weight ranged from 4 g to 63 g with live weight ranging from 3.443 kg to 6.485 kg. Analysis of the data indicated no significant correlation between physical characteristics and testes weight or volume. In summary, data from this research indicates that selecting or culling males based upon external physical characteristics is not an effective method for evaluating broiler breeder males for physiologically reproductive traits.

Key Words: Testes,, Sexual maturation,, Male management

M44 Effects of age on nitrogen mass balance of broilers. C. Smith*[1,2], J. Carey[2], J. Bray[1,2], and T. Cherry[1], [1]*Stephen F. Austin State University*, *Nacogdoches, TX*, [2]*Texas A&M University*, *College Station*.

A current important issue facing broiler producers involves the amount of nitrogen produced and subsequently released into the atmosphere from broiler production facilities. At the end of each growout caked litter must be removed from broiler facilities. A large percentage of broiler growers utilize pine shavings as litter in broiler houses and recycle litter from flock to flock. Thus, a study was conducted under simulated commercial broiler production conditions to more accurately measure litter and caked litter production, as well as perform a nitrogen mass balance for different ages during normal broiler production. Broiler chicks and feed were obtained from a commercial integrator and one flock was reared on recycled litter upon which two flocks had previously been reared. Birds were housed in twenty-four 10' X 10' pens with 134 broilers placed per pen, such that at 49 days of age 0.75 square foot per bird was allowed. Broilers were feed a commercially produced starter, finisher, withdrawl-1, withdrawl-2, and withdrawl-3.

To determine the nitrogen mass balance at varying flock age, all incoming and outgoing sources of nitrogen were sampled. Incoming sources of nitrogen include broiler chicks and feed. Outgoing sources of nitrogen include litter, cake, carcasses, mortality, and loss in the form of dust and ammonia. Samples and broiler weights were taken at Day 0, 21, 35, and 49 of age. All samples were analyzed for moisture and total nitrogen content and mass balance was calculated on a dry matter basis. Litter production, nitrogen content of the litter, and nitrogen loss was greater among older birds. This experiment aids in determining the impact of age on litter characteristics and nitrogen loss.

Key Words: Broiler, Nitrogen mass balance, Moisture, Litter, Age

Monday, January 22
Processing and Products
Room: B315

M45 Effects of low refrigeration temperature storage on quality characteristics of shell eggs. M. A. Sartor*[1], J. Regenstein[2], and M. X. Sánchez-Plata[1], [1]*Texas A&M University*, *College Station*, [2]*Cornell University*, *Ithaca, NY*.

The egg processing industry reports that storage of shell eggs at low refrigeration temperatures (close to 0°C (32°F)) during retail display may be associated with quality deterioration. Typical problems reported include ″running whites″ and ″flaccid yolks″. Standard quality parameters and functional properties of shell-eggs stored at -1.1, 0.6, 2.2, 3.9, 5.6 and 7.2°C were evaluated at days 0, 2, 7, 14, 21 and 28 under simulated retail conditions. Quality parameters evaluated included yolk and white color (Minolta), yolk index, Haugh units, pH and vitelline membrane strength. Additionally, foaming properties (cake density) and coagulation properties of the egg products (yolks and whites) were also determined. As expected, the pH of the albumen increased over the time of storage at all storage temperatures tested. The vitelline membrane strength was the lowest when the eggs were stored at -1.1ºC. No significant differences associated with the temperature of storage were observed. However, significant differences in pH, Haugh units and yolk index were evident when comparing samples tested at the beginning of the experiment (day 0 and day 2, compared to day 28). Storage of shell eggs at temperatures below 1ºC may affect some of the quality parameters and functionality of egg products, especially the albumen. Shell eggs need to be maintained at temperatures below 7 ºC as recommended by the USDA guidelines; however, storage temperatures should be kept above 1ºC to minimize these changes.

Key Words: Egg storage, Vitelline membrane strength, White color, Yolk index, Haugh units

M46 Effect of immersion or dry air chilling on bacteria recovery from broiler carcasses. R. Huezo*[1], J. K. Northcutt[2], D. P. Smith[1], D. L. Fletcher[3], and R. J. Buhr[1], [1]*University of Georgia*, *Athens*, [2]*USDA-ARS*, *Athens, Georgia*, [3]*University of Connecticut*, *Storrs*.

A study was conducted to investigate the effect of chilling method (air and immersion) on *Escherichia coli*, coliforms, *Campylobacter*, and *Salmonella* counts and prevalence recovered from broiler carcasses. During each of four replications, 60 broilers were inoculated orally and intra-cloacally with 1 mL of a suspension containing approximately 10^8 cells/mL of *Campylobacter*. After one day, broilers were inoculated with 1 mL of a suspension containing approximately 10^8 cells/mL of *Salmonella*. Broilers were processed and carcasses were cooled by dry air (3.5 m/s, -1.1 C, 150 min) or immersion chilling in ice water (0.6 C, 50 min). Pre-chill counts recovered from carcasses averaged 3.5, 3.7, 3.4, and 1.4 $\log_{10}$ cfu/mL of rinse for *E. coli*, coliforms, *Campylobacter*, and *Salmonella*, respectively. Overall, both chilling methods significantly reduced bacteria levels on the carcasses, and no difference in the bacteria counts was observed between the two chilling methods ($P < 0.05$). Both chilling methods reduced *E. coli* and coliforms levels by 0.9 to 1.0 log units. Chilling reduced *Campylobacter* levels by 1.4 log (air) and 1.0 log (immersion), while *Salmonella* reductions were 1.0 log and 0.6 log units for air and immersion chilling, respectively. Chilling method had no effect on the prevalence of *Campylobacter* and *Salmonella* recovered form carcasses. These results demonstrate that air and immersion chilled carcasses, without any chemical intervention, are microbiologically comparable, and a 90% reduction in counts of *E. coli*, coliforms, and *Campylobacter* can be obtained after chilling.

Key Words: Broilers, Immersion chilling, Air chilling, Cross contamination, Carcass microbiology

M47 *Enterobacteriaceae* isolated from packer head brushes in commercial shell egg processing plants. J. D. Shaw*[1], M. T. Musgrove[2], and D. R. Jones[2], [1]*University of Georgia*, *Athens*, [2]*Egg Safety and Quality Research Unit, ARS, USDA*, *Athens, GA*.

Plant sanitation is an integral component of process control and is crucial to ensuring a wholesome product. This study is an extension of previous work designed to evaluate the status of egg contact surface sanitation in commercial shell egg processing plants. Packer head brushes are placed after the washers and are one of the last pieces of equipment to come in contact with the egg, and therefore may have an important effect on egg cleanliness. In the current study, two egg processing plants were sampled three times each: an offline plant (OL) and a mixed operation plant (MO). While in operation, one packer head brush at each packer head lane was sampled by running a moistened sterile gauze pad across the length of the brush. The gauze pads were then aseptically packaged and transported to the laboratory at refrigerated temperature. *Enterobacteriaceae* were enumerated by plating 1 ml of diluent on violet red bile glucose agar with overlay and incubated at 37 C for 24h. A larger number of *Enterobacteriaceae* were recovered from the MO plant packer head brushes than from those sampled at the OL plant (1.7 log cfu/ml and 0.069 log cfu/ml, respectively). From each positive plate, up to five typical colonies were picked at random, streaked for purity, and subjected to biochemical testing for identification to genus or species. A total of 121 isolates were

identified: 13 from OL and 108 from MO. Genera recovered included *Citrobacter*, *Enterobacter*, *Escherichia*, *Klebsiella*, *Moellerella*, and *Providencia*. At the OL plant, 84.6% of the isolates were identified as *Enterobacter*; of the isolates identified from the MO plant, 68% were *Escherichia*. These genera are the two most commonly isolated from the shells of washed eggs. Five non-*Enterobacteriaceae* genera were found: *Acinetobacter*, *Burkholderia*, *Comomonas*, *Pasteurella*, and *Sphingobacterium*. Identifying bacteria from packer head brushes can assist researchers in developing more effective sanitation practices for the shell egg industry. This is the first report to describe genera associated with packer head brushes in commercial shell egg processing plants.

Key Words: Sanitation, Packer head brush, Enterobacteriaceae, Shell egg

M48 Effect of chilling method and post-mortem aging time on broiler breast fillet quality. R. Huezo*[1], J. K. Northcutt[2], D. P. Smith[2], and D. L. Fletcher[3], [1]*University of Georgia*, *Athens*, [2]*USDA-ARS*, *Athens, GA*, [3]*University Connecticut*, *Storrs*.

A study was conducted to determine the effects of chilling method (dry air or immersion) and post-mortem aging time on broiler breast fillet quality (raw fillet color, raw fillet pH, cook yield and Allo-Kramer shear). One hundred fifty eviscerated broiler carcasses were removed from a commercial processing line prior to chilling and transported to the laboratory. Half of the carcasses were chilled by dry air (3.5 m/s, -1.1 C, 150 min), while the other half were chilled by water immersion (0.6 C, 50 min). Immersion chilled (IC) carcasses were divided into 3 groups (0, 1.67 and 24 h) that corresponded to post-mortem fillet aging time on the carcass after chilling. Air chilled (AC) carcasses were divided into two groups (0 and 24 h). Because AC requires more time, AC fillets deboned immediately after chilling were aged for the same length of time as the 1.67 h IC fillets. One fillet from each carcass was used for raw pH and color (L*, a* and b*), while the other fillet was cooked (steam cooker, 95 C, 15 min) and used to determine yield and texture. The pH of IC and AC fillets was similar when fillets were aged for the same length of time post-mortem. Method of chilling has no effect on raw breast fillet color ($P < 0.05$); however, post-mortem aging time had a significant, but slight affect on lightness. Tenderness of IC fillets removed 0 and 1.67 h after chilling was similar and corresponded to the texture previously designated as slightly tough to tough by sensory panels (Allo-Kramer shear > 8 kg/g). Force to shear AC fillets deboned immediately after chilling (8.4 kg/g) was significantly lower than IC fillets (10.3 kg/g) aged for the same length of time (1.67 h). After 24 h aging, shear values for IC and AC fillets were < 8 kg/g and values were in the range considered to be tender to very tender by sensory panels. Cook yield of AC fillets was significantly higher than IC fillets for all deboning times. Results show that rigor may develop at a faster rate during AC as compared to IC; however, post mortem aging is still required to maximize tenderness.

Key Words: Poultry chilling, Air chilling, Immersion chilling, Poultry texture

M49 Effect of immersion or dry air chilling on broiler carcass moisture retention and breast fillet functionality. R Huezo*[1], D. P. Smith[2], J. K. Northcutt[2], and D. L. Fletcher[3], [1]*University of Georgia*, *Athens*, [2]*USDA, ARS, Russell Research Center*, *Athens, GA*, [3]*University of Connecticut*, *Storrs*.

A study was conducted to investigate the effect of chilling method on broiler carcass skin color, carcass moisture retention, and breast fillet quality and functionality. One hundred fifty eviscerated broilers carcasses were removed from a commercial processing line prior to chilling, transported to the laboratory, weighed and chilled by dry air (3.5 m/s, -1.1 C, 150 min) or immersion in ice water (0.6 C, 50 min). Post-chill carcasses were weighed for moisture uptake, individually bagged and held at 4 C for 24 h. Fillets were deboned, marinated (20% wt:wt, 20 min, 3% salt: 2% STTP) and cooked (steam cooker, 95 C, 15 min), with weights taken at each step. Carcass skin color was measured immediately after chilling and after 24 h. Fillet color was measured on the medial surface before marination and after cooking. Cooked fillets shear values were determined using an Allo-Kramer multiple blade. After 150 min of air chilling, carcasses lost 2.5% of pre-chill weight, and weight loss ranged from 3.5% to 2.2%. Water absorption during immersion averaged 9.3% of the pre-chill weight, but varied widely with a range of 3.4% to 14.7%. Immediately after chilling, Immersion chilled (IC) carcasses were significantly lighter (higher L*), less red (lower a*), and less yellow (lower b*) than air chilled (AC) carcasses. Storage time improved appearance of AC carcasses, but skin color after 24 h of storage was still significantly different for the two chilling methods ($P<0.05$). Raw and cooked fillet color, fillet marination pick-up, and cooked fillet tenderness were not affected by chilling method. Cook yield for fillets deboned from IC carcasses was significantly lower than fillets deboned from AC carcasses. Results suggest that immersion chilling is better for whole birds and skin-on parts; however, air chilling is acceptable for deboned and further processed items as fillet color, marination yield and tenderness is not affected, while cook yield is improved.

Key Words: Broilers, Immersion chilling, Air chilling, Marination, Poultry meat color

M50 Validation of a chlorine dioxide product applied pre- and post- chilling to reduce bacterial levels in broilers. V. Molina*, M. Davis, and M. Sánchez-Plata, *Texas A&M University*, *College Station*.

Selectrocide™, a chlorine dioxide (CD) generating product, was validated as an antimicrobial intervention applied before and/ or after chilling in a commercial broiler processing facility. Five different scenarios were simulated during each of three independent plant visits. A control plant scenario consisted in sampling 10 different carcasses at each of three different stages including after evisceration, after a chlorine rinse (50ppm), and after a 1h static chilling in icy-water (2ppm chlorine). Interventions tested in this experiment created 4 additional plant scenarios. The second scenario featured pre-chill carcasses sprayed with an acidified sodium chlorite (ASC), Sanova™, solution (1,200ppm) with samples taken after the intervention and after chilling. The third scenario featured pre-chill samples submerged for up to 30s in a 10ppm CD solution and sampled 1 minute after treatment application, and after chilling. A fourth scenario consisted of samples subjected to the intervention post-chill; while the fifth scenario featured post-chill samples subjected to the CD intervention before and after chilling. Standard sampling methods were used to evaluate aerobic plate, coliform, generic *E. coli* and psychrotrophic

counts, as well as the incidence of *Salmonella* spp. Significant variability in *Salmonella* spp. incidence was observed between replications. In general, similar bacterial reductions were achieved by the pre-chill application of acidified sodium chlorite and the chlorine dioxide product. Coliform counts in final carcasses for each of the five scenarios were 3.38, 2.58, 2.04, 2.10 and 2.19 log CFU coliforms/ ml of rinse, respectively. Generic *E. coli* levels in final carcasses for each plant scenario were 2.50, 2.10, 2.00, 1.65, 1.57 log CFU/ ml of rinse, respectively. Final psychrotrophic counts for each scenario were 3.42, 3.52, 3.51, 2.66, 2.27 log CFU/ ml of rinse, respectively. Post-chill application (last two scenarios) of the chlorine dioxide product significantly reduces bacterial populations, especially generic *E coli* and spoilage organisms.

Key Words: Chlorine dioxide, Pre-chill, Post-chill intervention, Acidified sodium chlorite, *Salmonella*

M51 Ultra-violet light treatment lowers numbers of *Listeria monocytogenes* on raw chicken fillets without changing antibiotic resistance or meat color. S. A. Lyon*[1], M. E. Berrang[1], D. L. Fletcher[2], and P. J. Fedorka-Cray[1], [1]*USDA-ARS-Russell Research Center*, *Athens, GA*, [2]*University of Connecticut*, *Storrs*.

Listeria monocytogenes is an important foodborne pathogen and raw poultry meat has been shown to be a vector for its entrance into a poultry further-processing plant. Reduction of *L. monocytogenes* in these plants is a high priority for the industry. Ultra-violet (UV) light at a wavelength of 254 nm is called germicidal UV and can kill bacteria. This study was designed to test germicidal UV light as a means to lower *L. monocytogenes* counts on raw chicken meat prior to shipment from a slaughter plant to a further processing plant. Raw chicken breast fillets were inoculated with one of four subtypes of *L. monocytogenes* each with a different antibiotic resistance profile. Inoculated fillets were exposed to UV irradiation at 1,000 $\mu W/cm^2$ for 5 min. Untreated control samples were maintained for comparison. All fillets were rinsed in PBS and L. monocytogenes were enumerated by plating serial dilutions on modified oxford medium. UV treatment resulted in a 2 Log reduction in viable *L. monocytogenes*recovered from fillets. Antibiotic resistance profiles were determined using the broth micro-dilution method. UV irradiation did not alter the antibiotic resistance profiles of any of the 4 *L. monocytogenes* strains as compared to those isolated from non irradiated fillets. Likewise, UV treatment had no effect on meat color (lightness, redness, and yellowness) on the day of treatment or after 7 days of storage at 4°C. This study suggests that UV irradiation of raw breast fillets at a slaughter plant can significantly reduce *L. monocytogenes* without negatively affecting meat color or changing antibiotic resistance among the surviving population. UV treatment may be useful to reduce the negative impact of *L. monocytogenes* introduction into a poultry further-processing plant on raw poultry meat.

Key Words: Ultraviolet irradiation, Poultry processing, *L. monocytogenes*, Antibiotic resistance, Meat color

M52 The effects of paraffin wax and a wax antimicrobial product to reduce microbial levels in processed chicken broilers. M. X. Sánchez-Plata*, *Texas A&M University*, *College Station*.

The suspension of approved antimicrobial treatments into a molten paraffin wax matrix was evaluated as a potential intervention in commercially processed broilers. Bacterial reductions on carcass surfaces were expected after submersion in a hot coating wax product, followed by physical removal of attached bacteria to the solidified residue, and the antimicrobial effects of a chemical intervention suspended in the wax matrix. A total of 420 market age broilers, were processed in a pilot plant research facility and were subjected to four different processing scenarios. Control samples were humanely slaughtered, scalded in a water tank at 58ºC, picked using a pilot scale picker, manually eviscerated and chilled in a static icy-water tank (2ppm chlorine). For treatment 1, a separate set of carcasses were submerged in a molten paraffin wax product kept at 60ºC for 1 second, followed with immediate submersion in icy water to allow the manual removal of the solidified wax coating. For treatment 2, carcasses were submerged in molten wax for 15 seconds, followed with immediate submersion in ice water. For treatment 3, carcasses were treated with molten wax that had a suspended chlorine dioxide (CD) generating product. Samples taken after bleeding, scalding, picking, waxing, evisceration, and chilling were tested for total aerobic, coliform and generic *E. coli* counts as well as *Salmonella* spp. incidence using standard methodologies. The immediate submersion in the wax product was responsible for a 0.3 to 0.5 log CFU/ ml of rinse reduction in total aerobic, coliform and generic *E. coli* counts. No significant reductions in the incidence of *Salmonella* spp. were observed. Reductions of 0.5 to 0.9 CFU/ ml of rinse in all the parameters tested were observed by the 15 s submersion in the wax product and the submersion in the wax product suspended with the CD product. Results indicate that the thermal, physical and chemical potential of paraffin wax as an antimicrobial intervention could assist processors in reducing overall bacterial levels in processed broilers.

Key Words: Paraffin wax, Intervention, Antimicrobial, Microbial levels, *Salmonella*

M53 The effect of tasker blue applied at various intervention steps on aerobic plate counts and *Escherichia coli* counts on fresh broiler chicken carcasses. S. M. Russell*, *University of Georgia*, *Athens*.

A study was conducted to evaluate the effect of Tasker Blue (TB-sulfuric acid, ammonium sulfate, and copper sulfate) applied at various locations in a commercial processing facility on aerobic plate counts (APC) and *Escherichia coli* (*E. coli*) counts on fresh broiler chicken carcasses. TB was applied in the scalder (pH 2, Cu 3 ppm), as a New York Dressed (NYD) spray, as an online reprocessing (OLR) treatment (10 second dip was used offline to mimic a 10 second spray treatment), and as a post-chill dip (TB treated offline at pH 3.5, Cu 3 ppm) for 10 s. Ten carcasses were sampled after scalding (PS), after NYD spraying (PNYD), pre-online reprocessing (Pre-OLR), post-online reprocessing (Post-OLR), and post-chill (PC) for controls or PC dip (PCD) for TB carcasses at each of these locations using the whole carcass rinse procedure. Likewise, 10 carcasses were selected from the adjacent processing line and sampled as controls. After collecting from the lines or dip tanks, the carcasses were allowed to drip for 1 min, individually placed into sterile bags, packed on ice in coolers, transported to the laboratory, and evaluated for APC and *E. coli* counts. Log_{10} APC results for the control line were 5.44, 4.18, 5.50, 4.60, and 3.43 for PS, PNYD, Pre-OLR, Post-OLR, and PC, respectively. Log_{10} APC results for the TB treated line were 2.95, 3.29, 3.76, 0.97, and 0.00 for

PS, PNYD, Pre-OLR, Post-OLR, and PCD, respectively. Log_{10} *E. coli* results for the control line were 3.20, 2.65, 4.66, 3.73, and 0.43 for PS, PNYD, Pre-OLR, Post-OLR, and PC, respectively. Log_{10} *E. coli* results for the TB treated line were 2.27, 1.50, 2.60, 0.00, and 0.00 for PS, PNYD, Pre-OLR, Post-OLR, and PCD, respectively. Tasker Blue, applied at various locations throughout the processing operation, dramatically and significantly ($P \leq 0.05$) lowered APC and *E. coli* on broiler carcasses when compared to a commercial poultry processing line.

Key Words: APC, *E. coli* count, Tasker Blue, Chicken

M54 Effect of washing broiler carcasses in potassium hydroxide and lauric acid on native bacterial flora. A. Hinton Jr*, J. K. Northcutt, J. Cason, D. P. Smith, and K. D. Ingram, *Russell Research Center*, *Athens, GA*.

Experiments were conducted to examine the bactericidal effect of potassium hydroxide (KOH) and lauric acid (LA) on the native microflora of broiler carcasses. Eviscerated carcasses were placed in solutions of 1.0% KOH and 2.0 % LA or in distilled water (control) and washed by shaking for 1 min on a mechanical shaker. Whole-carcass-rinses (WCR) were performed to recover bacteria from the carcasses following each of 3 successive washes in KOH-LA or water. Bacterial populations of WCR rinsates were enumerated by plating serial dilutions of rinsates on bacteriological media. Total plate count bacteria (TPC), *Campylobacter*, and *Escherichia coli* in the native bacterial flora were enumerated by culturing rinsates on Plate Count Agar, *Campylobacter* Agar, and Petrifilm, respectively. Results indicated that significantly fewer TPC bacteria were recovered from carcasses washed in KOH-LA than from carcasses washed in water; however, there was no significant difference in the number of TPC bacteria recovered from carcasses washed 1, 2, or 3 times in KOH-LA. Additionally, significantly fewer TPC bacteria were recovered from carcasses washed once in water than from carcasses washed 3 times in water. No *Campylobacter* or *E. coli* were recovered from carcasses following the first KOH-LA wash, although log_{10} 2.71 *Campylobacter*/ml and log_{10} 0.95 *E. coli*/ml were recovered from carcasses following the first wash in water. Repeated washing in water did not significantly reduce the number of *Campylobacter* recovered from the carcasses, but no *E. coli* were recovered from carcasses after the third wash in water. Findings indicate that the antibacterial activity of KOH-LA can significantly reduce populations of native bacterial flora of broiler carcasses washed in the mixture. Reduction of the number of pathogenic and spoilage bacteria on processed carcasses washed in KOH-LA might reduce the number of foodborne illnesses associated with processed poultry products and extend the shelf life of fresh poultry.

Key Words: Lauric acid, Potassium hydroxide, Antimicrobial, Broilers, Carcasses

M55 Assessment of wing damage during catching and processing as a measure of animal welfare performance. K. N. Opengart*, R. Williams, W. Hammack, and A. Atencio, *Keystone Foods*, *Huntsville, AL*.

Meeting current animal welfare standards for wing disarticulation and breakage during catching and processing has proven to be one of the most difficult parameters to consistently achieve. In most audit systems, an acceptable level of wing damage is 1% for broilers <4.5 pounds, 3% for broilers 4.5 to 7 pounds and 5% for broilers greater than 7 pounds when measured prior to defeathering. These arbitrarily assigned targets are sometimes difficult to attain. Therefore, systematic and scheduled evaluation of the process is necessary to quickly identify when and where deficiencies may be occurring that will ultimately lead to damaged wings which may put a plant out of tolerance. Evaluation of wing breakage measured in the cage once the birds arrived at the plant (a measure of catching and hauling) has shown catch crew related wing damage to be 1.0-1.5%. An additional 1-4.5% wing damage was associated with unloading, conveying and shackling when measured prior to defeathering. Areas of opportunity that have been identified as potential causes of excessive wing damage include human:animal interfaces (catching, unloading, shackling), shackling systems (height, shackle spacing), stunning systems, conveyance systems (turns, drops) and factors which may increase bird activity.

Key Words: Wing, Breakage, Disarticulation, Welfare

M56 Non-feed withdrawal broiler processing. Y. Vizzier-Thaxton*[1], A. Corzo[1], M. Putsakum[1], Z. Williams[1], S. W. Anderson[1], K. Christensen[2], and J. P. Thaxton[1], [1]*Mississippi State University*, *Mississippi State*, [2]*OK Foods, Inc.*, *Ft. Smith, AR*.

To minimize fecal contamination in the processing plant, a feed withdrawal period has been considered necessary. With the modern high meat yield broiler there have been reports of excessive yard shrink as a result of holding time and feed withdrawal. At the same time, feed withdrawal has been singled out as a time when broilers are most likely to eat litter and thus arrive at the processing plant with *Salmonella* in the crop. The feeding of organic acids in the water has been practiced in an effort to control the pH of the crop and thus inhibit *Salmonella* attachment or colonization. This study was designed to determine if a feed could be formulated that would allow birds to eat until immediately prior to catching to minimize shrink and at the same time acidify the crop. A total of 600 birds were divided into 2 treatment groups and placed in mini-pens with 10 birds per pen. Twelve hours prior to catching, one group received the experimental diet while feed was removed from the other group. At catching birds were bled for plasma corticosterone analysis. Birds were immediately euthanized. The crops were aseptically removed for pH and coliform counts. The intestinal content and condition was observed and photographed. Shrink was reduced by 44% with no apparent difference in fecal content between treatments. Crop pH was lowered. This work indicates that it may be possible to keep birds on feed up to catching time.

Key Words: Feed withdrawal, Shrink, Crop acidification, *Salmonella*

M57 Tylosin applied at a sub-therapeutic level in broiler feed affects *Campylobacter* recovered from carcasses during processing. M. E. Berrang*, S. R. Ladely, R. J. Meinersmann, and P. J. Fedorka-Cray, *USDA-ARS-Russell Research Center*, *Athens, GA*.

Tylosin is an antimicrobial drug approved for use in broiler feed at sub-therapeutic levels for purposes of growth promotion. There is controversy about whether such use of antimicrobials could lead to the development of drug resistant pathogenic bacteria. Erythromycin is

often the drug of choice for treating humans with campylobacteriosis. Both tylosin and erythromycin are classified as macrolide drugs and cross resistance between these antimicrobials may occur if either is used. Commercial broiler chicks were placed in isolation grow-out chambers and colonized with *Campylobacter jejuni*. At 14 days of age broilers began to receive a diet including 20 g tylosin phosphate per ton which was continued ad libitim for the rest of grow-out. Control broilers received the same diet with no added drugs. At 42 days of age, broilers were processed in a pilot plant with equipment which very closely models commercial conditions. Carcass rinses were collected after feather removal, after inside/outside washing and after immersion chilling. *Campylobacter* numbers after feather removal were not different according to feed type (3.53 log cfu per ml rinse for control carcasses and 3.60 for those fed medicated feed). Likewise, medicated feed did not affect *Campylobacter* numbers on carcasses after inside/outside washing (3.11 and 3.07 log cfu per ml rinse). Carcasses of broilers fed medicated feed had lower numbers of Campylobacter after chilling (1.45 log cfu/ml rinse) compared to control carcasses (2.31 log cfu/ml rinse). No *Campylobacter* isolated from control carcasses were resistant to erythromycin. However, all *Campylobacter* recovered from carcasses fed medicated feed were resistant to erythromycin (minimum inhibitory concentration of greater than 8 Î¼g/ml). Application of tylosin in feed can act to promote growth and results in lower *Campylobacter* numbers on chilled carcasses; however, the *Campylobacter* that do remain are resistant to erythromycin.

Key Words: *Campylobacter*, Tylosin, Processing, Feed, Antimicrobial

Monday, January 22
SCAD I (Avian Diseases)
Room: B312

M58 Animal rghts and eoterrorism - Current and emerging threats to animal researchers and commercial poultry. R. A. Norton*, G. S. Weaver, and N. R. Morrow, *Auburn University*, *Auburn, AL*.

Animal Rights extremism is one of the top domestic terrorist issues for the FBI. Originally confined to targeting animal research laboratories, some groups have developed extensive campaigns aimed at animal agribusiness and retail food operations. Legal challenges have also been mounted to dramatically alter animal production systems. The U.S. has experienced an escalation in direct action violence and calls for further violence. Recently a number of splinter groups have openly called for violence against people they feel harm animals.

Currently, there is no open source intelligence indicating animal rights groups are attempting to develop biological or chemical weapons to use against animal agriculture. Although counterintuitive, several activist leaders have openly wished U.S. animal production systems would experience foreign animal diseases (FAD). Potential threats that could cause catastrophic impacts include Highly Pathogenic Avian Influenza or Velogenic Newcastle Disease. Since many animal rights organizations have world-wide reach, infectious materials could be diverted from endemic disease areas and introduced into susceptible animal populations.

Significant changes are needed to harden poultry production facilities. Locked gates are not the answer. Growers need to be trained to recognize when animal rights groups or “lone wolves” are active in the community or conducting surveillance. Veterinarians and animal scientists also need to be trained to distinguish between naturally occurring diseases and those which are intentionally introduced. Combined, better defenses can lessen the probability of attack and better assure the continuation of a safe and secure food supply.

Key Words: Animal rights extremism, Current and emerging threats

M59 Performance improvement with feed additives RepaXol®, AciXol™, and Virginiamycin in broilers challenged with clostridium perfringens. G. Mathis*[1], C. Hofacre[2], and N. Scicutella[3], [1]*Southern Poultry Research, Inc.*, *Athens, GA*, [2]*University of Georgia*, *Athens*, [3]*SODA Feed Ingredients*, *Monaco*.

The objective was to evaluate the anticlostridial efficacy of feed additives RepaXol®, an homogeneus blend of double coated essential oils, AciXol™, a blend of organic and inorganic acids (citric, fumaric, malic and ortho-phosphoric) along with the protected essential oils (as in RepaXol®, encapsulated in the same MICROPEARLS®, and Virginiamycin, an antibiotic. Groups of 10 birds were weighed and placed into cages on day of hatch. The treatments were nonmedicated, non-challenged (NMNC), nonmedicated, challenged (NMC), RepaXol® 100 ppm, challenged, AciXol™ 500 ppm, challenged, and Virginiamycin (VIR) 20 ppm, challenged. Birds were challenged at 14 days of age with E. acervulina and E. maxima and on Days 19, 20, and 21 with Clostridium perfringens. Each treatment consisted of 6 replications in a complete randomized block design. Feed in mash form was fed ad libitum throughout the test period. The parameters measured were feed conversion and weight gain (Days 0 to 28 and Day 14 to 28), Necrotic Enteritis (NE) mortality and NE lesion scores. On Day 22, five birds per pen were NE lesion scored. There was a significant improvement of feed conversions and weight gains for both measurement periods with all feed additives compared to the NMC birds. The feed conversions (Day 0-28) of the NMNC was 1.461g, NMC, 1.726, RepaXol® 1.586, AciXol™ 1.577g, and VIR 1.519. The average live weight gains (Day 0-28) of the NMNC was 0.963 kg, NMC 0.774 kg, RepaXol® 0.915 kg, AciXol® 0.901 kg, and VIR 0.935 kg. Percent NE mortality was significantly less for the VIR 12 % compared to NMC 33 %. There was no significant difference in percent NE mortality between RepaXol® 23 %, AciXol™ 22 % and VIR. All feed additive treatments had significantly lower NE lesion scores compared to NMC. This study demonstrated the benefits of adding RepaXol® 100 ppm, AciXol™ 500 ppm, or Virginiamycin 20 ppm into the feeds of broiler chickens exposed to Clostridium perfringens.

Key Words: Clostridium perfringens, RepaXol, AciXol, Virginiamycin, Necrotic Enteritis

M60 Understanding *Salmonella* transmission on chicken pullet, broiler-breeder, and broiler farms in Georgia. K. Zamperini*[1], D. Cole[3], C. Hofacre[1], and J. Maurer[1,2], [1]*University of Georgia*, *Athens*, [2]*University of Georgia*, *Griffin*, [3]*Georgia Division of Public Health*, *Atlanta, GA*.

The prevalence of *Salmonella* within the various levels of the integrated poultry production system has not been fully elucidated, but vertical transmission is believed to be a significant contributor to carcass contamination by *Salmonella*. To investigate vertical transmission of *Salmonella*, we sampled two levels of poultry production for *Salmonella*: 1) select, paired pullet and broiler-breeder farms, and 2) broiler farms supplied with chicks from said broiler-breeder farms. Chick box liners were collected at the time of placement of the pullets and broilers in order to detect *Salmonella* strains present in the birds at placement. Of pullet farms surveyed, 26% of environmental samples were positive for *Salmonella*. Chick box liners were sporadically positive for *Salmonella*. Pullet farm houses have also been sporadically positive when sampled the day of placement. *Salmonella* prevalence varied within pullet farms, where *Salmonella* isolation rates ranged between 5 to 42%, for houses sampled on at least one-half of the pullet farms surveyed. While the initial *Salmonella* isolation rate from pullet farms was low at 2%, the number of houses and environmental samples positive for *Salmonella* increased with the age of the birds (chi-squared test, $p<0.05$). There was also a statistically significant difference between poultry integrators when comparing peak in prevalence with pullets' age (chi-squared test, $p<0.05$). No statistically significant differences were observed in *Salmonella* prevalence between poultry integrators (chi-squared test, $p=0.608063$) or pullet farms (chi-squared test, $p=0.780716$ and 0.155915 for companies A and C, respectively) despite differences in farm management practices evident with these the two integrators. Pulsed-field gel electrophoresis was used to identify strain types. Using this molecular typing tool, we were able to observe introduction and spread of *Salmonella* strains on poultry farms. Both vertical and horizon transmission appears to be involved in the spread of *Salmonella* within poultry integrator.

Key Words: *Salmonella*, Poultry, Vertical transmission

M61 Cationic peptides decrease susceptibility of young chickens to *Salmonella* enterica serovar enteritdis infection by up-regulation of the innate immune response. M. H. Kogut*[1], K. J. Genovese[1], H. He[1], and Y. W. Jiang[2], [1]*USDA-ARS*, *College Station, TX*, [2]*USDA-ARS*, *College Station, TX*, [3]*USDA-ARS*, *College Station, TX*, [4]*Texas A&M University*, *College Station*.

The TAMUS cationic peptides are a group of related cationic peptides produced by a Gram-positive bacterium. Cationic amphiphilic peptides have been found to stimulate or prime the innate immune responses in mammals. The innate immune system of poultry is functionally inefficient during the first week posthatch enabling pathogens such as *Salmonella* enterica serovar Enteritidis (SE) to invade and colonize the visceral organs of these immature birds. The objective of the present study was to evaluate the effect of TAMUS as an immunostimulator of the innate immune response of young chickens. TAMUS was provided as a feed additive at three different concentrations (12, 24, or 48 ppm) for 4 days post-hatch significantly increased protection against SE organ invasion in a concentration-dependent manner. The functional efficiency of heterophils isolated from chickens fed the TAMUS rations at the three concentrations was significantly up-regulated when compared to heterophils isolated from chickens fed a control starter ration as determined with an array of functional assays. Phagocytosis, oxidative burst, and degranulation were all significantly increased in a concentration-dependent manner in heterophils isolated from chickens fed the TAMUS diets. This is the first report of bacterial cationic peptides inducing the up-regulation of the avian innate immune response that provides protection against extraintestinal *Salmonella* infections. The significance of these data is that the orally delivered cationic peptides stimulate the innate response at a time of immunologic inefficiency and increased susceptibility to bacterial infections (first week posthatch). Because of the non-specific nature of the innate response, we speculate that TAMUS given as a feed additive during the first week posthatch could provide increased protection against a variety of bacterial pathogens.

Key Words: Cationic peptides, *Salmonella*, Innate immunity, Heterophils

M62 Herbal products for control of histomoniasis (blackhead disease) in turkeys. R. Hauck*, P. L. Armstrong, L. Fuller, and L. R. McDougald, *University of Georgia*, *Athens*.

In the absence of approved products for treatment of blackhead disease there is increased interest in the evaluation or use of natural products. Such products are used for other purposes in the feed industry and have good acceptance by producers and consumers. In this study we evaluated the effects of 3 such products which are used for odor management in feed. These products are extracts or essential oils from commonly used herbs. Tests of the products *in vitro* showed positive results against *Histomonas* and other protozoa. The test model in turkeys consisted of directly and indirectly exposed birds in battery cages. The products offered little protection against the severe direct infections. However, product 2 alone or in a combination with product 3 had beneficial effects on lesions in the liver and ceca. These results suggest that these products could have benefit in helping birds to resist the spread of histomoniasis within a flock.

Key Words: Histomoniasis, Turkeys, Treatment, Essential oils

M63 Comparison of *Mycoplasma gallisepticum* vaccine strain 6/85 dosage rates in layers subsequently challenged with virulent *Mycoplasma gallisepticum*: Serological response, vaccine persistence, and egg production. J. D. Evans*, S. A. Leigh, S. D. Collier, and S. L. Branton, *USDA-ARS South Central Poultry Research Unit*, *Mississippi State, MS*.

Commercially available attenuated strains of *Mycoplasma gallisepticum* (MG) are commonly used within the layer industry to control MG-induced mycoplasmosis. MG strain 6/85 is a commonly utilized vaccine strain which has been demonstrated to be safe due to reduced pathogenicity and transmissibility. Research has indicated that increased dosage rates or vaccination loads corresponded with an enhanced serological response and increased vaccine strain persistence within the host. In an effort to maximize protection associated with MG live vaccines and to further examine the effects of enhanced 6/85 dosage rates, Hyline W36 layers (n=160) were housed in biological isolations units (10 birds per unit) through 55 wks of age. The layers

were divided among 6 treatment groups: (1) subjects vaccinated with 6/85 at the recommended dosage (1X); (2) subjects vaccinated with 6/85 at 1X and challenged with virulent MG at 22 wks; (3) subjects vaccinated with 6/85 at 1X and challenged with virulent MG at 45 wks; (4) subjects vaccinated with 6/85 at the recommended dosage (15X); (5) subjects vaccinated with 6/85 at 15X and challenged with virulent MG at 22 wks; and (6) subjects vaccinated with 6/85 at 15X and challenged with virulent MG at 45 wks. Vaccinations occurred at 10 wks of age and were applied via fine spray. Throughout the study, eggs were collected and weekly hen production was determined. The *in vivo* persistence of 6/85 was determined via choanal cleft swabs/strain-specific PCR and the serological response was determined via serum plate agglutination (SPA). Preliminary results indicate that the seroconversion rates (measured at 50 wks) were not impacted by differing dosage rates of 6/85. Following virulent MG challenge at 45 wks, however, the 15X 6/85 treatment negated production losses readily evident with the similarly challenged 1X treatment group.

Key Words: Poultry, *Mycoplasma gallisepticum*, Attenuated vaccine, Mycoplasmosis

M64 The effects of stress and concurrent *Escherichia coli* infection on the isolation of *Listeria monocytogenes* from synovial tissue of turkey poults. V. Dutta*[1], G. R. Huff[2], W. E. Huff[2], N. C. Rath[2], M. G. Johnson[3], and R. Nannapaneni[3], [1]*University of Arkansas*, *Fayetteville*, [2]*USDA, ARS, PPPSRU*, *Fayetteville, AR, USA*, [3]*University of Arkansas*, *Fayetteville*.

The objective of this study was to determine if *Listeria monocytogenes* (Lm) infection of stressed turkey poults would result in colonization of synovial tissues. Male turkey poults, housed in floor pens, were subjected to cold stress from d 4 through 12 and were exposed to an aerosol challenge of either the Scott A strain of Lm, *Escherichia coli* (Ec), or the combination (Lm+Ec). All challenged birds were housed in the same building, while non-challenged controls were housed in a separate, biosecure building. At seven wks, poults were given an immunosuppressive dose of dexamethasone (Dex) and the same bacterial challenges were added to their drinking water. One wk post-challenge 4-6 birds per group were weighed, necropsied, and knee synovial tissues were cultured for Lm using pre-enrichment in University of Vermont medium (UVM) and Fraser broth, isolation of Lm on Listeria selective agar plates, and confirmation using biochemical tests. LM was isolated from knee synovial tissue of 75% of cold stressed poults challenged with Dex+Ec+Lm, 43% of cold-stressed poults challenged with Dex+Ec alone, and 20% of cold stressed poults challenged with Dex+Lm alone. Lm was not isolated from non-cold stressed birds challenged with either Dex+Lm or Dex+Ec+Lm, but was isolated from 25% of non-cold stressed birds challenged with Dex+Ec. Lm was not isolated from synovial tissues of any of the non-challenged controls. There were no differences in body weight due to early cold stress, however Dex treatment itself and Dex + all bacterial challenges significantly decreased body weight at 8 wks. These data suggest that Lm colonization of turkey synovial tissue can be enhanced by early cold stress and by concurrent infection of Dex-treated poults with Ec.

Key Words: Turkeys, Cold stress, *Listeria monocytogenes*, *Escherichia coli*

M65 Effects of vaccine stabilizer Spray-Vac™ on *Mycoplasma gallisepticum* vaccines FVAX-MG™ and Mycovac-L™ survival in solution. S. A. Leigh*, J. D. Evans, S. L. Branton, and S. D. Collier, *USDA-ARS South Central Poultry Research Unit*, *Mississippi State, MS*.

Infection of layer chickens with *Mycoplasma gallisepticum* (MG) can result in decreased egg production compared to uninfected hens. Live MG vaccines are available; however, the methods used to administer these vaccines by the end user vary, resulting in the potential for marked differences in vaccine efficacy. In order to help poultry growers obtain uniform results using the live vaccines, various conditions for vaccine delivery are being investigated. One area of investigation is the ability to use tap water for rehydration of lyophilized vaccines. However, the presence of chlorine or other oxidizing compounds in the water rapidly decreases vaccine viability. The use of a vaccine stabilizer (Spray-Vac™) that removes chlorine and other oxidizing compounds was investigated. Tap water for this experiment was simulated by adding chlorine (sodium hypochlorite) to distilled water to a final concentration of 4ppm. MG vaccines FVAX-MG™ and Mycovac-L™ were rehydrated with 10 ml distilled water and then diluted to a usable concentration in either tap water, or tap water containing vaccine stabilizer, or stabilizer with 0.1X or 1.0X PBS from concentrate added. 1.0X PBS concentrate in distilled water was used as a control. Samples were removed at 15, 30, and 60 min., and numbers of viable mycoplasmas were determined by measuring color-change units (CCU_{50}) per milliliter. The results show that chlorine rapidly decreases vaccine survival. The addition of the vaccine stabilizer removes the effects of the chlorine, yielding vaccine survival results similar to that obtained previously for distilled water. The best results were obtained when PBS concentrate was added to a concentration of 1.0X (physiological). These results show that vaccine stabilizer has no detrimental effects on vaccine survival, and can be used to remove the deleterious effects of chlorine from tap water.

Key Words: *Mycoplasma gallisepticum*, Mycoplasmosis, Poultry, Attenuated vaccines, Clorine

Monday, January 22
Nutrition II
Room: B313

M66 Effects of arginine, vitamin E and vitamin C on cardiopulmonary function and ascites parameters in broilers exposed to cold temperature. S. B. Kawthekar*, N. Rougiere, and C. Ruiz-Feria, *McGill University*, *Montreal, QC, Canada*.

One experiment was conducted to evaluate the combined effects of Arginine (AR), Vitamin E and Vitamin C on cardiopulmonary performance and ascites parameters of broilers reared under cold environmental temperature starting on d 16. One d old male broilers were fed with corn-soybean meal diet (CTL, 1.2 % AR and 40 IU vitamin E). The birds were assigned to four dietary treatments: CTL, control supplemented with 1% AR and either 200 IU vitamin E (AE), or 500 mg of vitamin C (AC), or a combination of vitamin E and C at the same levels (AEC) per kg of feed. Pulmonary Arterial Pressure (PAP) and Mean Arterial Pressure (MAP) were measured in anesthetized birds (n = 7 per group). Birds were challenged with epinephrine (EPI, 0.5 mg/kg BW i.v.), 20 min later with Amino- guanidine hemisulphate (AG, 100 mg / kg BW i.v.) and 20 min later with L-NAME (50 mg / kg BW, i.v.). PAP and MAP were recorded continuously after each challenge. Data were analyzed with the repeated measures ANOVA and the Student Newman-Keuls test was used to separate means within groups. The PAP values were lower ($P < 0.05$) in the AEC group as compared to all other groups after 30 s of EPI challenge. Within 120 s of EPI challenge, PAP were significantly decreased ($P < 0.05$) in the AEC birds compared to the CTL birds. The PAP returned to pre-EPI challenge levels within 300 s in all groups. The PAP increased ($P < 0.05$) 60 s after the AG and L_NAME challenge in all groups, but no differences were found among groups. The right to total ventricular weight was lower ($P < 0.05$) in the AEC birds as compare to the other groups. Hematocrit values ($P < 0.05$) were lower in the AEC group as compared to all other groups at 5 and 6 wks. EPI had a less severe effect on the cardio-pulmonary function of AEC birds, probably due to a better endothelial integrity and higher capacity to generate nitric oxide. In general AEC birds appeared to have a better pulmonary vasculature, and this may be explained by the extracellular and intracellular protection against oxidative stress provided by the combination of lipid and water soluble antioxidants.

Key Words: Arginine, Vitamin E, Vitamin C, Ascites, Nitric oxide

M67 Estimation of the relative bioavailability of copper sources for broiler chicks. P. Butkeraitis*[1], D. R. Ledoux[1], L. B. Linares[1], A. J. Bermudez[1], A. Dakovic[2], S. Matijasevic[2], and Z. Sekulic[2], [1]*University of Missouri*, *Columbia*, [2]*Institute for Technology of Nuclear and Other Mineral Raw Materials*, *Belgrade, Serbia*.

An experiment was conducted with 250 day-old male broiler chicks to estimate the biological availability of two sources of Cu, Cu-montmorillonite (Cu-MONT) and Mintrex®Cu. Copper sulfate ($CuSO_4$) was used as the standard source in the bioavailability assay. Chicks were allotted randomly to dietary treatments that included an unsupplemented basal corn-soybean meal, or the basal supplemented with 75, 150 or 225 mg Cu/kg diet as either $CuSO_4$ (25.1% Cu), Cu-MONT (2.65% Cu), or Mintrex®Cu (15% Cu). Chicks were housed in stainless steel chick batteries and allowed access to feed and water *ad libitum* for 21 d. Dietary Cu level or source had no effect ($P > 0.05$) on feed intake, body weight gain or feed conversion of chicks, which averaged 847 g, 696 g, and 1.22 g:g, respectively. A source x level interaction ($P < 0.05$) was observed for liver Cu. Liver Cu of chicks fed $CuSO_4$ and Mintrex®Cu increased with increasing Cu concentrations, whereas liver Cu in chicks fed Cu-MONT only increased at 225 mg Cu/kg diet. Bile Cu increased ($P < 0.0001$) with increasing dietary Cu and was higher ($P < 0.05$) for Mintrex® Cu (24.6 mg/L) compared with Cu-MONT (18.4 mg/L) and $CuSO_4$ (20.0 mg/L). Using the slope-ratio technique from regression of bile Cu on Cu intake with Cu from $CuSO_4$ set at 100%, the relative biological availability values and associated confidence intervals (CI) were estimated to be 93.8% (CI: 77.6 - 113.3%) and 115.5% (CI: 97.3 - 139.3%) for Cu-MONT and Mintrex®Cu, respectively. Data indicate that Cu from Mintrex®Cu was more available to broiler chicks than Cu from Cu-MONT.

Key Words: Copper, Bioavailability, Bile, Mintrex® Cu, Cu-MONT

M68 Effects of lignin and Bio-Mos on broiler performance and gut microbiology after *E. coli* and *Salmonella* challenge. B. Baurhoo*, C. A. Ruiz-Feria, and L. Phillip, *McGill University*, *Ste Anne de Bellevue, QC, Canada*.

Three experiments were conducted to evaluate the effects of virginiamycin, Bio-Mos and Alcell lignin using antibiotic-free diets on growth performance, feed efficiency, and cecal loads of Lactobacilli and Bifidobacteria (Exp. 1); cecal *E. coli* load after gavage (O2 and O88, Exp. 2); *Salmonella* internalization into jejunum after an in vivo challenge with S. enteritidis (PT4, Exp. 3). Dietary treatments for the 3 studies were: 1) antibiotic free (CTL-), 2) positive control (CTL+, 11 mg/kg virginiamycin), 3) MOS (diet 1 + 0.1% Bio-Mos), 4) LL (diet 1 + 1.25% Alcell lignin), and 5) HL (diet 1 + 2.5% Alcell lignin). 1040 day-old male Cobb 500 broilers were randomly assigned to the treatments (4 pen replicates). BW and feed intake did not differ among treatments. However, at d 35, feed conversion ratio was higher ($P < 0.05$) in birds fed CTL+ than CTL- fed birds. The cecal Lactobacilli load was highest ($P < 0.05$) in birds fed MOS or CTL- at d 28, and, at d 38, in MOS fed birds. At d 28 and 38, cecal Bifidobacteria loads were highest ($P < 0.05$) in birds fed MOS or CTL-, whereas Lactobacilli and Bifidobacteria loads were lowest ($P < 0.05$) in birds fed CTL+ or HL. At d 21, birds were transferred to cages for the *E. coli* challenge. At d 3 and 9 after *E. coli* challenge (n = 12), birds fed HL had lower ($P < 0.05$) cecal E. coli loads than CTL- or CTL+ fed birds. At d 9 after challenge, MOS fed birds had lower ($P < 0.05$) *E .coli* load than birds fed CTL- or CTL+. The *E. coli* loads did not differ in birds fed MOS, LL or HL. In *Salmonella* challenge study, at d 31, birds fed MOS or HL had lower ($P < 0.05$) internalized *Salmonella* in the jejunum than CTL- fed birds. Moreover, *Salmonella* load was lower ($P < 0.05$) in HL fed birds than those fed CTL+; but not different in birds fed CTL+, CTL- or LL. Therefore, as compared to birds fed CTL+, birds fed MOS and lignin had increased cecal Lactobacilli and Bifidobacteria loads, and, in the challenge studies, lower cecal E. coli and internalized *Salmonella* loads. MOS and lignin could potentially replace antibiotic growth promoters in poultry production.

Key Words: Broilers, Gut health, Antibiotic, Bio-Mos, Lignin

M69 Bioefficacy of an exogenous protease from *Bacillus amyloliquefaciens* in corn/soy-based diets for broilers. A. J. Cowieson[1], E. E. M. Pierson*[3], and J. M. McNab[2], [1]*Danisco Animal Nutrition*, *Marlborough, Wiltshire, United Kingdom*, [2]*Roslin Nutrition*, *Roslin, Midlothian, United Kingdom*, [3]*Danisco Animal Nutrition*, *St Louis, MO*.

The efficacy of an exogenous protease was examined using a total of 200 male Ross broiler chickens in a 5 treatment and 8 replicate 21d growth study. A maize/soy-based control diet was formulated to contain adequate concentrations of digestible P, Ca and energy (0.40%, 0.90% and 3070kcal/kg respectively) but to be marginal in Lys and TSAA (approx 85% NRC). This control diet was then supplemented with a bacterial protease at 3,000-40,000 U/kg. Weight gain was improved (P<0.05) by around 10% and FCR by around 3 points by supplementation of the diet with protease. Furthermore, the ileal digestibility of energy was improved (P<0.05) by around 90kcal/kg. Most of the beneficial responses were noted at 3,000-6,000 U/kg, with little additional benefit of supra-doses (up to 40,000 U/kg). Interestingly the ileal digestibility of N was not significantly improved with protease. The effect of protease on performance was assumed to be associated with an improvement in the retention of the limiting nutrients in this study (lys and SAA), however the measured responses were more apparent for energy than for amino acids. It is possible that the presence of exogenous protease in the GIT was detected via the CCK feedback mechanism, reducing pancreatic protease secretion and so lowering amino acid requirements of the animal. These net effects are interesting and require further elucidation. It can be concluded that protease is effective in improving performance of broilers fed corn/soy-based diets but the mechanisms are not fully understood.

Key Words: Enzymes, Protease, Corn, Soybean meal, Broiler

M70 Rapid and dramatic improvement in color intensity of brown egg shells from caged laying hens fed dietary CALSPORIN® (*Bacillus subtilis* C-3102 spores) in a commercial field trial in China. H. Miyazaki[1], S. Chou[2], M. Kato[3], and D. M. Hooge*[4], [1]*Calpis Co. Ltd*, *Tokyo, Japan*, [2]*Shanghai Naseco Ltd*, *Shanghai, China*, [3]*Calpis USA, Inc.*, *Elgin, IL*, [4]*Hooge Consulting Service, Inc.*, *Eagle Mountain, UT*.

China has a population of over 1.3 billion people with about 1.3 billion laying hens of which ~80% are brown egg strains. Uniformity and intensity of brown egg color are important marketing considerations because excellent brown egg color (and shell quality, as reported previously) can extend production, bring a premium price (Japan and Korea), or enhance marketing of natural and organic eggs (U.S.). Brown egg color becomes lighter as hens age. An investigation was conducted using dietary CALSPORIN®, a commercial direct-fed microbial product containing *Bacillus subtilis* C-3102 spores, to demonstrate the brown egg color enhancing effect of CALSPORIN® already observed in other situations. Lohmann brown hens, 65 wk 4 d (459 d), at Xiazhuang Egg Farm, Beijing, China and caged in 10 houses of 9,000 birds each, were fed CALSPORIN® for 13 d. Inclusion levels were 1 x10^6 CFU/g feed (3.33x) for 7 d (459 to 465 d) and 6 x 10^5 CFU/g feed for 6 d (466 to 471 d). Shell color was determined daily before and during CALSPORIN® feeding, except 1 d (446 d), from 63 wk 3 d (444 d) to 67 wk 1 d (471 d) from ~150 hens designated for the trial (84-125 eggs/d; collection d=26, 13 before and 13 during) using an egg color fan (1=light to 10=dark brown; Ghen Corp.). Daily weighted mean egg shell color scores were: before -- 6.02, 5.46, 5.15, 5.72, 5.68, 5.78, 5.83, 5.75, 5.56, 5.82, 5.60, 6.30, 5.92 (5.74, 13 d, n=1,393 eggs); during -- 6.12, 5.75, 5.87, 6.20, 6.10, 6.46, 6.60, 6.35, 6.50, 6.22, 6.47, 6.33, 6.84 (6.29, 13 d, n=1,321 eggs, vs 5.74 $P < 0.001$ by 1-way ANOVA). Compared to the period before, CALSPORIN® feeding increased egg counts in fan color score categories #7 (23.60% vs 14.11%, $P < 0.001$) and #8 (22.78% vs 17.98%, $P < 0.001$), and this shift was associated with a decreased egg count in #3 (5.03% vs 13.16%, $P < 0.001$). Dietary CALSPORIN® rapidly and significantly ($P < 0.001$) improved brown egg shell color.

Key Words: Bacillus subtilis C-3102, Brown egg, CALSPORIN, Color fan, Shell color

M71 Dose titration and safety margin of fumaric acid in broiler. A Schumacher[1], K Bafundo[2], K. M. S Islam*[3], H Aupperle[4], and J. M Gropp[1], [1]*Leipzig University*, *Leipzig, Germany*, [2]*Phibro Animal Health,Ridgefield Park*, *Ridgefield Park, NJ*, [3]*Bangladesh Agricultural University*, *Mymensingh, Bangladesh*, [4]*Leipzig University*, *Leipzig, Germany*.

Six isonitrogenous (22.8 % CP) and isocaloric diets (13 MJ ME kg-1) containing 0, 1.25, 2.50, 3.75, 5.0, and 7.5 % fumaric acid (FA), respectively, were fed for 26 days to 12 (replicates) x 8 (chicks per replicate) Lohmann-Hybrid newly hatched male chicks (48 g body weight) per treatment. The diets consisted mainly of wheat and soybean meal. Mortality ranged between 0 and 4 %. Final body weight (feed efficiency) amounted to 1,506 (756), 1,597 (767), 1,532 (754), 1,485 (759), 1,342 (738), and 1,378 g (747 g gain kg-1 feed) for the groups with 0, 1.25, 2.50, 3.75, 5.0, and 7.5 % FA, respectively. The 1.25 % FA group showed significantly (p<0.05) better weight gain than all other groups and better feed efficiency than the groups with 5.0 and 7.5 % FA. Higher gain was associated with higher feed intake. It is concluded that 1.25 % FA may promote growth of broilers, but the effect disappears with further increasing doses. Body weight of the 5.0 and 7.5 % FA groups was significantly lower than that of all other groups. The relative weight of heart, liver and spleen was not affected by the treatment. Pathological findings summarized to 5/10 in the 7.5 % FA group, to 1/10 in the control and to 2-3/10 in the other groups. The 7.5 % FA grouped showed also the highest incidence of kidney alterations. From the findings the margin of safety is concluded to be about 3 (3.75/1.25) considering 1.25 % FA in the diet as the optimally effective concentration.

Key Words: Fumaric acid, Performance, Safety, Broiler

M72 Effect of plane of rearing nutrition of broiler breeder females on body weight, egg production, fertility, and progeny performance. H Romero-Sanchez*[1], P. W. Plumstead[2], N. Leksri-sompong[2], K. E. Brannan[2], and J. Brake[2], [1]*Universidad de Antioquia*, *Medellin, Colombia*, [2]*North Carolina State University*, *Raleigh*.

An experiment was conducted to evaluate the effects of two levels of cumulative nutrient intake during the rearing period to 21 wk of age on female broiler breeder performance. A total of 1,120 day old Ross 308 female broiler breeders were reared in 16 floor pens in a blackout facility. From 0-2 wk all birds received a starter feed after which four

pens of pullets were randomly assigned to each of the experimental diets. Two diets were formulated and a single feeding program was used to achieve either a high or a low cumulative nutrient intake. The high cumulative nutrition program (HiDiet; 16.7% CP, 3.25 kcal ME/g) supplied 26.6 Mcal ME and 1,370 g CP, while the low cumulative nutrition program (LoDiet; 14% CP, 2.85 kcal ME/g) supplied 23.5 Mcal ME and 1,160 g CP to photostimulation at 21 wk of age. From 22 to 24 wk the two diets were blended to provide a gradual transition to a single common breeder diet (2,925 kcal/kg ME and 15% CP) that was then amended with calcium and fed throughout the production period. The HiDiet plane of nutrition increased female BW during the rearing period and the differences were maintained until 58 wk of age. The LoDiet plane group exhibited better egg production but no significant differences were observed for fertility, hatchability, or broiler progeny performance. The data showed that a cumulative nutrient intake during the rearing period of 23.5 Mcal ME and 1,160 g CP resulted in a bird of adequate BW at 21 wk of age that produced more eggs and was able to maintain good fertility without significant effects on progeny performance.

Key Words: Broiler breeder, Rearing nutrition, Growth, Fertility, Broiler performance

M73 Performance and health of broiler due to dietary humic acid. K. M. S Islam*[1], A Schuhmacher[2], C Ellenberger[3], H. -A Schoon[3], and J. M Gropp[2], [1]*Bangladesh Agricultural University,*, *Mymensingh, Bangladesh*, [2]*University of Leipzig*, *Leipzig, Germany*, [3]*University of Leipzig*, *Leipzig, Germany*.

Six diets containing 0, 0.3, 0.6, 1.2, 2.4, and 4.8 g Huminfeed® (74 % humic acid in DM) /kg were offered to 480 (6 treatmentsX10 replicatesX8 birds/replicate) Lohmann-Hybrid newly hatched male chicks to know the performance and health status. The diets formulated based on wheat and soybean meal (25.3 % CP, 12.8 MJ ME /kg). After 35 days feeding trial 60 birds (1 per replicate) were killed for necropsy. Initially HA depressed weight gain, but recovery started in the third week, so that at the end no significant differences could be observed (2,408, 2,369, 2,335, 2,355, 2,310 and 2,301 g for the groups with 0, 0.3, 0.6, 1.2, 2.4, and 4.8 g Huminfeed®/kg respectively). Feed intake was not affected by the treatment. Feed efficiency of the 4.8 g Huminfeed®/kg group was significantly lower (689) than control (723 g gain /kg feed) at the end of trial. Mortality ranged between 1.25 and 8.75 %, being highest in the control. The relative weight of liver, spleen, Bursa Fabricii and thyroid gland did not differ among the groups. Morphometric parameters (number and diameter of follicle, epithelial height, length and width of nucleus, number of hyperplasia and follicular epithelial index) of thyroid gland demonstrated absence of any dose related response of HA. So, the inclusion of HA at the level of 8 % (2.4/0.3) is possible without hampering performance and without causing any clinical condition in broiler.

Key Words: Humic acid, Broiler, Performance, Health

Monday, January 22
Environment and Management II
Room B314

M74 Effect of a hatchery nutrition supplement on broiler placement body weight and growth rate. S. Henderson*, J. Vicente-Salvador, C. Pixley, G. Tellez, and B. Hargis, *University of Arkansas*, *Fayetteville*.

Previously we have reported that administration of the perinatal nutrition supplement EarlyBird™ (EB; Ivesco, LLC) at a dose of 2 g/chick in chick boxes reduced body weight loss during 24-h simulated shipping conditions. Recently, we observed higher body weights at placement ($p<0.05$) in leghorn chicks (4.5%; 1.52 g) and broiler chicks (2.1%; 0.78 g) when chicks were weighed and treated (3 g EB/chick) prior to leaving the commercial hatchery and re-weighed upon arrival at the farm. To examine the effect of this conservation of weight on broiler chick performance, three experiments were conducted comparing the use of EB to no supplementation (NS). For each experiment, broiler chicks from a commercial hatchery were neck-tagged, individually weighed, and randomly placed in chick boxes (n=100/box). In all experiments, treated chicks received 2 g EB/chick in plastic chick boxes, covered boxes were immediately stacked, and held under ambient light (~42 FC). Following the 24-h simulated shipping period, chicks were individually weighed and randomly assigned to replicate pens. Body weights (BW) and BW gain (BWG) were determined at placement, 7, and 21 d (exps. 1-3), as well as 28 and 42 d (exp. 3 only). Weight loss prior to placement was reduced ($p<0.05$) by EB treatment in exp. 1 (1.86 g), exp.2 (0.92 g), and exp. 3 (1.63 g). EB treatment caused increased ($p<0.05$) BWG at 7 d in exp. 1 (11 %; 9.0 g), and exp. 3 (4.0 %; 3.6 g) and at 21 d in exp. 1 (2.7%; 16.1 g) and exp. 3 (2.1%; 14 g), with no difference in exp 2. Chicks in exp. 2 were unusually large at placement (49 g), but were 14% or 23% smaller at 7 d as compared to control chicks in exp. 1 and 3, respectively, suggesting suboptimal conditions for exp. 2. In exp. 3, EB-treatment increased ($p<0.05$) BWG at 28 d (3.1%; 34.7 g) and at 42 d (2.7%; 57.7 g). Hatchery application of EB reduced weight loss during chick transportation prior to placement in all experiments. Furthermore, in 2 of 3 experiments, hatchery treatment with EB resulted in continued segregation of BW and BWG during growth.

Key Words: Perinatal nutrition, Chick supplement, Performance, Early bird, Holding

M75 Brooding light intensity effects on broiler performance. A. J. Brown*[1], B. D. Fairchild[1], R. J. Buhr[2], and A. B. Webster[1], [1]*University of Georgia*, *Athens*, [2]*Russell Research Center, USDA-ARS*, *Athens, GA*.

Light intensity is an environmental factor which is used with a high degree of variation throughout the US Broiler Industry. Light intensity influences bird activity, immune response, growth rate and has been used to alleviate mortality issues related to metabolic disease (spiking mortality). The objective of the current study was to determine the effect of light intensity during the 10 days of brooding on bird performance. Two trials were conducted utilizing three light intensities

(15, 25, 45 lux). Each light intensity treatment was applied to chicks from day 1 through day 10. After day 10, the light intensity was reduced to 5 lux in each room. Each light treatment was applied to two rooms with six pens in each room. A bird density of 0.7 ft2 was used resulting in 40 birds per pen. Water and a standard broiler diet were provided ad libitum. Broiler management protocols followed the breeder company recommended guidelines.

In Trial 1, 25 lux resulted in significantly greater BW gain and gain to feed ratio but lower feed consumption at 7 days while 45 lux resulted in significantly greater BW gain at 21d. In Trial 2, BW gain and gain to feed were significantly greater for 25 and 45 lux when compared to 15 lux. No significant differences were noted among the treatments at 42 days of age in either trial. While there were differences in the results between the two trials, similar trends were apparent with the broilers provided 15 lux having the poorest performance. The results of the current study suggest that having light intensity too low (15 lux) during the brooding period will have negative results on broiler performance. The data from Trial 2 suggests that higher intensity light may be beneficial to broiler performance, but due to differences between the two trials the effects of intensities above 25 lux are inconclusive at this time.

Key Words: Broiler, Light intensity, Feed conversion, Lighting programs

M76 Effect of varying brooding management practices on broiler performance parameters and processing yield. A. H. Nilipour*[1], E. Robles[1], C. Rosales[1], F. Mora[2], and G. D. Butcher[3], [1]*Empresas Melo, S.A.,*, *Panama City, Rep of Panama*, [2]*Universidad de Panamá*, *Panama City, Rep of Panama*, [3]*University of Florida*, *Gainesville*.

With the advancing of genetics, health care and nutrition, the time period allotted for broilers to achieve optimal market body weight and meat characteristics is decreasing. The first two weeks of life comprise more than 30% of the broiler lifespan. A broiler from setting lives about 1500 hours (500 hrs incubating, 336 brooding, and 700 hrs growing). Management during the first 336 hrs (2 wks) affects final performance. A study was conducted at the Empresas Melo Experimental station where a total of 1692 Cobb X Cobb female and male broilers were sexed and randomly allocated into 36 pens of 47 chicks each. Feed and water were provided ad libitum, and commercial feeds were utilized. Two brooding management treatments were utilized each containing 18 replicates of 9 female and 9 male pens with total of 846 birds. Treatments were 1- Normal Management (NM) and 2- Modified Management (MM). Both trts had 23 hrs light for 7 days, MM had 20 hrs light till 14 days. Heat brooding extended from 9 to 14 days and chicks had access to an extra feed tray. Birds were individually weighed on arrival at DOA and weekly, thereafter. Feed consumption per pen was weighed to calculate the weekly and accumulative feed conversions (FC). Percent mortality and culls were calculated. At 43 DOA a total of 56 birds (14 per sex and trt) were randomly selected and eviscerated, and all parts collected and weighed. Weekly body weights and index were in favor of MM. However, at 42 DOA, weights were equal. Throughout the study MM % uniformity was consistently higher (3-6%), conversions (-2-3 points). Total carcass yield were 68.93, 67.48%, respectively, in favor of MM. Front halves were 37.47, 36.93, with % breast being 31.46, and 30.55%. When all meats (breast, thigh and muscle) were considered, 35.10 vs. 34.28% of the chicken is meat. MM improved total production costs by 0.25 cents per pound. Applying MM improved broiler performance parameters such as FC, uniformity while at the same time improved the salable part of the chickens, especially of breast meat.

Key Words: Broilers, Yield, Management, Chicks, Brooding

M77 Evaluation of drinking water or post-pelleting probiotic administration alone or in combination with a phytogenic product on broiler performance. D. J. Caldwell*[1], N. H. Eckert[1], J. T. Lee[1], S. M. Stevens[1], R. Beltran[2], M. Mohnl[2], and G. Schatzmayr[2], [1]*Texas A&M University*, *College Station*, [2]*Biomin GmbH*, *Herzogenburg, Austria*.

The present trial was conducted to evaluate the effects of either drinking water or post-pelleting feed application of a commercially available probiotic, Biomin® PoultryStar, alone or in combination with a phytogenic product, Biomin® P.E.P. 125 Poultry, on broiler performance during a 48 day pen study. Probiotic was administered to broilers either through the drinking water or by post-pelleting feed application. Phytogenic product was administered by inclusion within the starter and grower diets during grow-out. Experimental groups included a non-treated control group, a probiotic group with intermittent drinking water administration, a post-crumble or post-pelleting probiotic application by feed group, and a phytogenic product administration by feed group. On day of placement, 1,880 straight-run broiler chicks were randomly distributed to 40 pens allowing for 10 replicate pens per group. Broilers were reared on litter consisting of half used litter from a commercial broiler house and half fresh pine shavings. Feed and water were provided to all broilers ab libitum. The ration fed to broilers in both trials was a standard corn-soy ration fed in a four diet feeding program (starter, grower, finisher, and withdrawal). Drinking water application of probiotic was by a medicator system in place within the grow-out house. Across experimental groups, broilers receiving intermittent administration of probiotic by the drinking water performed better in terms of body weight gain and feed conversion. Specifically, body weights were higher ($P<.05$) on days 15, 30, and 40 of grow-out in broilers in the drinking water probiotic group. Similarly, feed conversion was improved ($P<.05$) in broilers receiving probiotic by drinking water application between days 1 and 40 of grow-out. Phytogenic product administration within the starter and grower phases of grow-out was not associated with increased body weight gain but was associated with improved ($P<.05$) feed conversion between days 1 and 40 of this trial.

Key Words: Probiotic, Phytogenic product, Drinking water, Post-pelleting, Broiler performance

M78 Drinking and eating as related to type of drinking fountain in broilers. J. P. Thaxton* and Z. T. Williams, *Mississippi State University*, *Mississippi State*.

Two separate trials were conducted, one during spring and the other during summer. In both trials 5 wk-old broilers were reared in pens (1.84 x 3.68 M) possessing fresh pine shavings litter in a curtain-sided grow-out facility. This facility was power ventilated and natural lighting prevailed. Ten chicks were maintained in each pen and each

bird was marked with paint so that individuals could be identified. Each pen possessed a centrally located hanging-type feeder and either a single Plasson drinking fountain or a nipple fountain that consisted of six nipples each of which was calibrated to deliver between 35 and 40 mL/min. In both trials, on d 36 through 40 two pens of birds were observed for 60 min starting at 0800 h. The observer recorded numbers of drinking and eating actions, as well as the time duration of each action on an individual bird basis. Results show that incidences of drinking and eating actions, as well as the durations of these actions, were not different among individual birds. However, seasonal differences in numbers of drinking and eating actions were found. Specifically, in spring birds averaged 2.46 drinks/h and 2.36 eating actions/ h and in summer these averages increased to 6.58 drinks/h and 4.36 eating actions/ h. Durations of drinking and eating times were also influenced by season. Average duration of a drink in spring was 45.6 sec and 73.1 sec in summer, while average eating time in spring was 169.6 sec and 113 sec in summer. The type of drinking fountain also influenced both numbers of drinking actions, as well as average duration of each drink. The number of drinks for birds over both seasons with nipple drinkers was 6.08 and 2.96 for those with a Plasson fountain. The average drinking time over both seasons from nipple drinkers was 80.3 sec and 38.5 for the Plasson drinker. Average eating time for birds drinking from nipples was 125.9 sec and those drinking from a Plasson fountain were 156.8 sec.

Key Words: Drinking, Season, Eating, Broiler

M79 Water consumption as a broiler management tool. B. D. Fairchild*[1] and M. Czarick[2], [1]*University of Georgia*, *Athens*, [2]*University of Georgia*, *Athens*.

Many broiler farms have water meters to monitor bird water consumption and most modern house environmental controllers are able to accept inputs from water meters and log the daily consumption. Water consumption is a parameter that while monitored is not utilized extensively in broiler house management however, it is a useful tool that when utilized, can provide timely information about bird performance and health status. The recent models of many of the computer controllers common in broiler houses are now accepting multiple digital inputs that allow several water meters to be used per house. So in theory a water meter could be used to monitor water in the front of the house, the back of the house, the evaporative cooling system, etc. A field evaluation of bird water consumption on several commercial broiler farms has been conducted utilizing two water meters per house for several years. Monitoring bird density in the front and back of houses has proven to be effective in determining the effects uneven bird distribution has in broiler houses. Observations have been made when bird distribution in houses differed as much as 40% between the front and back. Using digital photographs of the birds allowed estimates of bird density to be made in different areas of the houses. Comparing water consumption within the houe and using those comparisons to determine flock distribution between front and back of the house has resulted in bird distributions within 1 to 2 percent on subsequent flocks.

Individual water lines in the houses have also been monitored for the last six months with the objective of examining water use among the different lines in the house as well as various management factors that might influence water consumption. Most houses have four to five drinker lines in each end of the house. These studies have shown the inner water lines are used 25% more than the outer water lines. The difference in water consumption between the inner and outer lines appeared to decline as the birds get older. The results of this evaluation indicate that water consumption can be a useful tool in day to day broiler house management.

Key Words: Broiler, Drinking water, Management

M80 Growth performance of Rock Partridge (Alectoris graeca) under intensive conditions. S. Dikmen*, F. Alpay, and M. Petek, *University of Uludag*, *Bursa, Turkey*.

Partridge′s are game birds in the wild and there are four major markets: hunting preserves, gourmet food markets (mostly restaurants), individuals who buy live birds for custom slaughter and individuals who want to restock birds in the wild. And also recently it has been shown that partridge, especially the rock partridge, can also be raised for meat production. A trial was conducted to determine the growth performance and survival rate of rock partridge under intensive conditions. Seventy eight 1-day-old chicks were used. Chicks were weighed at hatching and fortnightly and recorded. Feed consumption was determined at the same time and the feed conversion ratio (kg feed / kg gain) was calculated. The experimental period was 16 weeks with the first 8 weeks as the starter period and the last 8 weeks as the grower period. Liveweight of partridge′s (g) at hatching, 1 mo, 2 mo, 3 mo and 4 mo of age were found 14.64±0.19, 73.27±1.94, 251.66±3.99, 390.72±7.23 and 457.82±8.33, respectively. Cumulative feed consumption (g) and feed conversion ratio (kg feed / kg gain) were found 2883 and 6.51, respectively, at the end of the study. Survival rate at 1 mo, 2 mo, 3 mo and 4 mo of age were found 84.2, 82.4, 70.1 and 63.1% respectively. In conclusion, under intensive conditions partridge′s perform a good growth performance but survival rate is low for mature age. According to the results of this study, further studies can be done for improving partridge performance and survival rate.

Key Words: Rock partridge, Growth performance, Survival rate

Monday, January 22
Environment and Management III
Room: B315

M81 Evaluate performance parameters and evisceration yield when incorporating two US Corn (before and after Katrina) vs. Argentinean corn. A. H. Nilipour*[1], R. Fabrega[1], E Robles[1], F Mora[2], and G. D. Butcher[3], [1]*Empresas Melo, S.A.*, *Panama City, Rep of Panama*, [2]*Universidad de Panama*, *Panama City, Rep of Panama*, [3]*University of Florida*, *Gainesville*.

Corn is a major imported grain used in poultry feed in Panama. Its quality can greatly influence production parameters and intestinal health. Due to hurricane Katrina, imports from the US were halted, thus Argentinean corn and fresh US corn, when imports were reestablished, were utilized. A study was conducted at the Empresas Melo Experimental station where a total of 1692 Cobb X Cobb female and male broilers were sexed and randomly allocated into 36 pens of 47 chicks each. Standard management practices were applied and commercial feeds with different corns utilized. Three treatments were utilized each containing 12 replicates of 6 female and 6 male pens with total of 564 birds. Treatments were 1- Control. US corn A (USCA), 2- Corn B (USCB), and 3- Argentine Corn (ARGC). Birds were individually weighed on placement, at DOA, and weekly, thereafter. Feed consumption per pen was weighed to calculate the weekly and accumulative feed conversions. Percent mortality and culls were also calculated. At 50 DOA a total of 18 birds (9 per sex) per treatment were randomly selected and eviscerated. The final body weights USCA vs. ARGC (+74 grams), conversions (-2 points) and performance index (6 points) were improved when CARG was used. There was 0.42 cents reduction in production cost utilizing Katrina corn. Total carcass yields were 71.31, 70.60 and 71.01%, respectively. Front halves of the breast % being 31.71, 31.06 and 31.25%. When all meats (breast, thigh and muscle) added, 37.48, 37.46, and 38.48% of the chicken is meat. ARGC inclusion improved total meat yield 1%, over US corn diets. Older US corn consistently had lower performance parameters, while ARGC improved body weight, feed conversion, and saleable part of the chickens, especially of breast meat.

Key Words: US corn, Argentinean Corn, Broilers, Yield

M82 The impact of two incubator systems upon moisture content in eggs and chicks. S. L. Funderburk*[1], M. J. Wineland[1], J. Beavers[2], J. Shepard[2], H. R. Cutchin[1], K. M. Mann[1], V. L. Christensen[1], and E. O. Oviedo-Rondon[1], [1]*North Carolina State University*, *Raleigh*, [2]*Mountaire Farms*, *Siler City, NC*.

Understanding how the environment within both single stage (SS) and multi-stage (MS) systems affects chick quality is needed by the industry in order to produce optimal quality chicks. Once an understanding of each system type is established, management of the systems can be done in order to have a significant impact on the economic return to both the integrator and the grower. The objective of this project is to compare the effects of SS and MS systems on chicks at hatching. Experiments were conducted to evaluate egg and chick characteristics between the incubator systems. Eggs of prime Ross 708 flocks were weighed and incubated, using SS and MS systems. At D18 eggs were reweighed and moisture loss was calculated. At hatch chicks were randomly sampled from each treatment. Sampling was done by carefully separating the chick and residual yolk and weighing to the nearest 0.01g. Yolk and chick samples were dried down in a 70°C oven in order to remove all moisture. Moisture content of the chick and residual yolk were calculated. SS and MS incubation systems affected the moisture loss among eggs and chicks differently. MS systems consistently lead to approximately a 2% higher moisture loss among eggs throughout incubation. Among chicks more moisture was found in the yolk of chicks hatching from SS systems, while the amount of dry yolk matter was less compared to the MS system. Yolk weights of chicks hatching from MS systems were higher, where chick weights were lower compared to the SS systems. Therefore, a higher percentage of chick to initial egg weight was found among SS systems. The incubation environment can affect the amount of moisture that is lost from the eggs and the moisture present in the chick at hatching. Additionally, the incubation system may have an effect on the ability of the embryo to utilize nutrients during incubation and impact the quality of the chick at hatching.

Key Words: Single stage, Multi-stage, Moisture loss

M83 Turkey embryo muscle growth and physiology is affected by incubator temperature and oxygen concentrations. V. L. Chrisensen*, M. J. Wineland, J. L. Grimes, D. Ort, S. Funderburk, P. E. Mozdziak, E. de Oviedo, and K. M. Mann, *North Carolina State University*, *Raleigh, NC*.

Incubator temperature and oxygen concentration may affect embryonic muscle development. Randomly selected turkey eggs were set in the same incubator for the initial 24 days of incubation. At that time, the eggs containing viable embryos were randomly divided into groups and placed in four experimental cabinets until hatching. Each cabinet was operated at temperatures (T) and oxygen concentrations (Ox) in a 2 T (36° and 39°C) x 2 Ox (17 and 23%) factorial arrangement. At 27 and 28 days of incubation, 10 embryos or poults were sampled from each cabinet. Blood was obtained following decapitation. The pipping (musculus complexus), breast (pectoralis thoracicus) and thigh muscles (gastrocnemus) were collected from each embryo, and each muscle was placed in cold 7% perchloric acid (5 mL/g of muscle) for glycogen and lactate analysis. An additional 5 embryos were sampled for histological analyses of muscle fibers. Blood plasma creatine kinase (CK) and lactate dehydrogenase (LDH) activities were measured. T and Ox affected muscle growth differently. Pipping muscle weights at day 27 were higher ($P<0.05$) for 23% Ox compared to 17% Ox, and T and Ox exhibited a significant interaction at hatching to affect the pipping muscle weight. Breast muscle weights increased at 27 days for 39°C compared to 36°C but the reverse was noted at hatching. The thigh muscle weight was affected only at hatching as 23% Ox weights were higher compared to 17% and 36°C weights were higher compared to 39°C, but the two factors did not interact. The CK and LDH activities were also affected at 27 days because 39°C incubation was associated with elevated CK and LDH activities, compared to 36°C. At 28 days, only CK was affected as 39°C elevated CK activity in the 23% oxygen environment, but not in the 17% environment. Thus, incubator conditions affect muscle development and function in poults.

Key Words: Embryo, Muscle grow and function, Incubation

M84 A new technique for measuring core temperatures of commercial broilers. K. D. Christensen*[1,2] and J. P. Thaxton[1], [1]*Mississippi State University*, *Mississippi State*, [2]*O.K. Industries, Inc.*, *Fort Smith, AR*.

Understanding core temperatures of commercial broilers should allow the identification of exact temperature profiles to maximize performance and bird welfare. Three trials were conducted to determine the feasibility of using Radio Frequency Identification microchips (RFID) with temperature-sensing capability to monitor deep core temperatures of broilers compared to rectal temperatures taken with a digital thermometer. In Trial 1, Day-old commercial broiler chicks were implanted with an RFID subcutaneously in the area between the wings or gavaged with an RFID. Temperatures collected from the RFIDs were compared to rectal temperatures. Implanted RFIDs provided temperatures throughout the 49 day trial period. RFIDs in the gizzard remained in the gizzard for up to 10 days but were either damaged by the muscular contractions of the gizzard or expelled. In Trial 2, commercial broilers were implanted with an RFID, or gavaged with an RFID. An antenna and microprocessor installed in the pen was used to collect and store the temperature data over time. In addition, rectal temperatures were taken and compared to RFID temperatures recorded at the same time. In Trial 3, an RFID was attached to the probe of a digital thermometer. Rectal temperatures of random birds were taken daily until Day 10 and then weekly through Day 49 from two commercial houses with two temperature profiles. Rectal temperatures and RFID temperatures were taken simultaneously using the modified probe. Results of these trials indicate that RFID can be a useful tool to monitor body temperature of commercial broilers. Using this information to improve the growing environment of commercial broilers should result in improvements in performance. Many advances in bird welfare can be made with a thorough understanding of the response of deep core temperatures to management practices.

Key Words: Body temperature, Commercial broilers, Microchip, Welfare, New technique

M85 Dietary calcium, phytate, and phytase control water soluble P excretion from broilers. A. B. Leytem*[1], P. W. Plumstead[2], R. O. Maguire[3], P. Kwanyuen[4], and J. Brake[2], [1]*USDA-ARS*, *Kimberly, ID*, [2]*North Carolina State University*, *Raleigh*, [3]*Virginia Tech*, *Blacksburg*, [4]*USDA-ARS*, *Raleigh, NC*.

Soluble phosphorus (P) in broiler litter and manure is important from an environmental perspective as it is related to potential off site P losses following land application. The effects of altering dietary P, calcium (Ca), phytate P, and the addition of phytase on litter and manure P excretion in broilers were investigated. Study I consisted of a 3 x 3 x 2 factorial treatment structure that was applied from 14 to 42 d of age with 3 levels of available P (AvP) of 0.35%, 0.30%, and 0.25% combined with 3 levels of Ca of 0.80%, 0.69%, and 0.57% with phytase applied at either 0 or 600 FTU/kg. Study II consisted of a 3 x 4 factorial treatment structure that was applied from 16 to 20 d of age with 3 levels of dietary phytate P (0.10%, 0.23%, and 0.27%) combined with 4 levels of dietary Ca (0.47%, 0.70%, 0.93%, 1.16%). To assess treatment effects on P excretion, fresh litter was collected when the broilers were 41 d of age in Study I, and fresh manure was collected when broilers were 20 d of age in Study II. Litter and manure were analyzed for total P, soluble P, and phytate P. Results indicated that the inclusion of phytase at the expense of inorganic P, reductions in AvP, or reductions in dietary phytate P decreased total P excretion. The ratio of Ca:AvP in the diets was negatively correlated with the solubility of P in the litter and manure. The effect of Ca on decreasing soluble P was greater in diets having a greater phytate P concentration. The ratio of litter soluble P:total P increased with phytase additions at all ratios of Ca:AvP. These data indicated that a decrease in litter or manure total P could be obtained by feeding diets with reduced AvP and phytase or by reducing phytate P in diets. However, the ratio of Ca:AvP in the diet was primarily responsible for effects on soluble P and was more pronounced in diets containing higher levels of phytate P.

Key Words: Broiler, Phosphorus, Soybean meal, Phytate, Environment

M86 Influence of early light intensity on broiler performance and yield. J. B. Hess*[1], S. F. Bilgili[1], and E. R. Miller[2], [1]*Auburn University*, *Auburn, AL*, [2]*Mountaire Farms*, *Siler City, NC*.

Broiler strain responses to lighting programs continue to evolve as commercial strains change over time. The current trial examines the effects of light intensity during the first 9 d on Aviagen 708 broilers. Light intensities of 1, 2, 4 or 8 footcandles (fc) (23 h light; 1 h dark) were used on mixed-sex broilers (25 male and 25 females placed/pen) fed diets suggested by Aviagen (4 treatments, 4 light-controlled chambers/trt). At 9 d, all pens were switched to 20 h light and 0.25 fc. Light duration was returned to 23 h (0.25 fc) from 50 to 55 d. Body wt, uniformity and adjusted feed conversion ratio (FCR) were measured at 9 and 54 d. Mortality was monitored weekly and was summarized at 54 d. All birds were processed at 55 d to assess chilled carcass, abdominal fat, front half and parts yields.

Body wt were similar for 1, 2 and 4 foot candles at 9 d (236, 231, 234g respectively), while wt for birds given 8 fc was significantly ($p < 0.05$) lower (226g). No differences were seen in CV at 9 d, 54 d wt (although birds started on 8 fc had the lowest body wt numerically, 3839 vs 3870, 3859 and 3864g), FCR or mortality. Carcass yield of birds given 8 fc to 9 d was lower than that of birds given 4 fc (74.6 vs 75.7 %). Lean carcass yield showed similar results. No differences were seen in abdominal fat, front half yield or leg quarter yield. Fillet yield was lower in birds given 8 fc to 9 d than in those given 1 or 4 fc (19.5 vs 19.8 and 19.7% respectively). No differences in wing, tender or total breast yield were recorded. Early light intensity appeared to influence growth in Aviagen 708 broilers, with intensities up to 4 fc showing no growth reduction.

Key Words: Light intensity, Broiler, Yield

M87 Effects of three lighting programs during grow on performance of commercial egg laying varieties. 1. Growing period. N. P. O'Sullivan*, P. Settar, J. Arango, S. Saxena, and J. Arthur, *Hy-Line International*, *Dallas Center, IA*.

An experiment was set to compare the effect of slow (SL), moderate (ML) and rapid (RL) step down light programs (LP) during the growing period of commercial layers. Experiments were carried out in two phases: PH1 (Spring 2005) compared W36 and W98, and PH2 (Fall

2005) included one white (W98) and one brown (HYB) egg variety. A total of 500 pullets per variety were individually wing banded at hatching, and moved to the grow house by variety with 20 h of light during the first week. Three replicates were kept in separate pens by variety-LP during the rest of the growing period. The LP differed in the rate of step down duration of artificial light exposure. All groups started with 20 h light at week one; thereafter, the light exposure decreased 1h/2wk (SL), 1h/wk (ML) and 4h/wk (RL), to 13, 9 and 12 h at weeks 15, 12 and 3 for SL, ML and RL, respectively. Thereafter, SL plateaued at 13 h of light ML and RL plateaued at 9 h till week 17 when all treatments received 10 h of light. Weekly individual body weights (BW) were collected in the grow house up to 17 weeks of age, when the birds were transferred to the layer house. Body weight records were analyzed by variety using least square means procedures. Model included the effect of LP and pen within LP, age (wk) and its interaction with LP and residual. The models' R-squares were over 0.93 for both lines and phases. There were significant differences in growth due to LP. In general, BW was highest for SL and smallest for RL, being intermediate for ML. In PH1 SL birds were, relative to ML and RL, respectively, +18 and +52 g for W36, and -4 and +20 g for W98. In PH2 these figures were +23 and +36 g for W98, and +24 and +45 g for HYB. The SL treatment resulted in heaviest pullets. Final conclusions are pending results of the residual effect of LP during laying on production and egg quality.

Key Words: Laying hens, Growing, Body weight, Light programs, Lighting

M88 Effects of three lighting programs during grow on performance of commercial egg laying varieties. 2. Laying period egg production. J. Arango*, P. Settar, S. Saxena, J. Arthur, and N. P. O'Sullivan, *Hy-Line International*, *Dallas Center, IA*.

An experiment was set to compare laying period effects of slow (SL), moderate (ML) and rapid (RL) growing light programs (LP). The experiments were carried out in two phases: PH1 compared W36 and W98, while PH2 included one white (W98) and one brown (HYB) egg variety. A total of 500 pullets per variety were wing banded, and grown by variety with 20 h of light during the first week. Three replicates were kept in separate pens by variety-LP during the rest of the growing period. All groups started with 20 h light at week one; thereafter, the light exposure decreased 1h/2wk (SL), 1h/wk (ML) and 4h/wk (RL), to 13, 9 and 12 h at weeks 15, 12 and 3 for SL, ML and RL, respectively. Thereafter, SL plateaued at 13 h of light and ML and RL plateaued at 9 h till week 17 when all treatments received 10 h of light. Afterwards, 2h/wk light increase was applied to 16 h, and then kept constant during the whole laying period. Data were collected on sexual maturity (SM), daily production (PD), and individual weekly body weights (BW). Production records were analyzed by variety using least square means procedures. Model included the effects of LP, week of production and their interaction. Data were analyzed as daily hen housed production pooled by week of production. Additional models treated week of production as a regressor variable at different degree polynomial. Significant PD differences occurred among LP, especially during the pre-peak period. The RL excelled in PH1 due to an earlier SM and higher peak of production. On average, SL birds were 44 and 87 g heavier than ML and RL for W36 and 38 and 83 g forW98. In PH2, LP was not significant for PD in HYB but SL birds were 24 and 45 g heavier than ML and RL. For W98, PD trend was similar to that in PH1, and SL birds were 12 and 51 g heavier than ML and RL. Final conclusions are pending analysis of egg quality and bone density traits.

Key Words: Laying hens, Sexual maturity, Production, Body weight, Light programs

Tuesday, January 23, 2007

SCAD II (Avian Diseases)
Room: B312

T89 Development and initial evaluation of a candidate M2e-based avian influenza vaccine utilizing recombinant *Salmonella* as a vaccine vector. S. L. Layton*[1], K. Cole[1], M. M. Cox[1], J. L. Gallagher[1], T. Jiang[1], Y. M. Kwon[1], L. R. Berghman[2], W. J. Bottje[1], and B. M. Hargis[1], [1]*University of Arkansas*, *Fayetteville*, [2]*Texas A&M University*, *College Station*.

The M2 ion transport protein extracellular domain (M2e) is highly conserved among influenza A viruses. Antibodies against M2e have conferred protection against influenza challenge in previously-reported research. We have recently developed several novel attenuated ΔaroA *Salmonella enteritidis* strains (ΔSE) that express a protective epitope of M2e with or without linkage to a potential immune-enhancing 10 aa CD154 sequence (CD154). These avirulent *Salmonella* mutants were evaluated as live vaccine candidates (~10^5 or 10^7 cfu/chick by oral gavage at day-of-hatch) for invasiveness and M2e seroconversion. Constructs evaluated included ΔSE, ΔSE containing M2e (ΔSEM2e), ΔSEM2e linked to CD154 (ΔSEM2eCD154), or ΔSE containing multiple copies of M2e linked to CD154 (ΔSEHM). At 7 d, liver+spleen and ceca tonsils were aseptically removed for detection of ΔSE mutant recovery (enrichment), and blood samples were obtained for M2e-specific IgG antibody response against M2e at 10 and 20 d. Within doses, no significant ($p>.05$) differences were observed in ΔSE construct recovery from cecal tonsils at d 7. However, marked differences in organ invasion were observed (ΔSE: 7/10, ΔSEM2e(10^5): 1/10, ΔSEM2e(10^7): 10/10, ΔSEM2eCD154(10^5): 4/10, ΔSEM2eCD154(10^7): 9/10, ΔSEHM(10^5):1/10, ΔSEHM(10^7): 5/10, $p<.05$). M2e-containing ΔSE constructs elicited M2e seroconversion

(S/P-ratio; p<.05) with higher responses from higher vaccination doses at d 20. ΔSEM2e produced higher M2e seroconversion at d 20 than the ΔSEHM, but seroconversion was not detectable in any group at d 10. When SP-ratios 2 STD higher than ΔSE-only controls were considered as positive responses, 70% (14/20) ΔSEM2e and 85% (17/20) ΔSEM2eCD154 responded by d 20. Ongoing experiments are focused on duration of response and effect of booster vaccination. These early data suggest that effective M2e seroconversion is possible with this *Salmonella*-vectored vaccine. Such a vaccine could offer advantages relating to stability of epitope and cost of amplification and administration.

Key Words: Avian Influenza, *Salmonella*, Vaccine Vector, M2e, Chicken

T90 Development and initial evaluation of a biosensor for in field screening of avian influenza virus. Y. Li*[1,2], R. Wang[1,2], L. Lassiter[1,2], B. Hargis[1], S. Tung[2], L. Berghman[1], and W. Bottje[1], [1]*University of Arkansas*, *Fayetteville*, [2]*Texas A&M University*, *College Station*.

An important step in controlling the spread of avian influenza is rapid and sensitive detection of the virus in the field. Thus, a biosensor, originally developed for microbial detection, has recently been modified to enable detection of avian influenza virus. The biosensor consists of a sampler, a microfluidic chip, and impedance detector attached to a microprocessor. In preliminary studies, magnetic nanobeads were coated with specific antibodies to targeted H5N1 (killed) avian influenza virus and used in the automatic sampler to separate target viruses from a poultry swab sample. Red blood cells were mixed with the captured target viruses to form an antibody coated nanobead-virus-red blood cell complex as a result of hemaglutination with the H5N1 virus. The complexes were then sent to a microfluidic chip that was designed and fabricated as a flow-through device with an embedded interdigitated array microelectrode for impedance measurement. The change in impedances of the antibody coated nanobead-virus-red cell complex was correlated to the concentration of avian influenza virus H5N1 in a poultry sample. Results of these studies indicate that the biosensor was very sensitive (102 EID50/ml) in detection of killed H5N1 virus in buffer and when the virus was added to cloacal and tracheal swab samples. No false positives were observed when unknowns were tested with various combinations of killed viruses consisting of H5N1, infectious bronchitis, and exotic newcastle disease. The total amount of time required for in-field detection would be 20 to 30 min. Thus, the biosensor could be potentially used both in detection of H5N1 in commercial poultry, but also in wild bird populations and backyard chickens or village chickens found throughout the world.

Key Words: Biosensor, Avian influenza, In-Field detection, H5N1 virus, Swab sample

T91 Molecular and antigenic characterization of recent H5N1 avian influenza isolates from Vietnam. J. Pfeiffer* and D. L. Suarez, *Southeast Poultry Research Laboratory*, *Athens, GA*.

A recent sequence comparison of the hemagglutinin (HA) gene of Asian H5N1 avian influenza viruses isolated over the past 10 years demonstrated separation into three clades with recent isolates separating into two clades. Most reported viruses from Vietnam from 2001-2005 clustered in Clade 1, but 19 viruses isolated from the northern part of Vietnam from December 2005 all were clade 2 viruses. These viruses clustered into two sublineages, with no apparent clustering based on origin of the viruses. Genetic relatedness for the other genes also showed two unique clusters that correlated with the HA gene. Additionally, we evaluated the antigenic relatedness between these Vietnamese viruses by cross hemagglutination inhibition (HI) tests using antisera generated with DNA vaccines in chickens. Hemagglutinin-specific sera collected was to be used against either homologous antigen or antigen from the other Asian viruses against which antibodies to their HA genes were produced. We also wanted to evaluate the effectiveness of various vaccines using two Vietnamese challenge viruses that represented each genetic sublineage. Two-week old white leghorn chickens were vaccinated with one of five oil emulsion vaccines, two of which are currently used in Vietnam. Three weeks later, these birds were challenged with 10^6 EID_{50} virus. Clinical protection was seen with four of the vaccines, and real-time RT-PCR was used to evaluate levels of shedding among the groups. By compiling the data from these various analyses of the recently isolated Vietnam highly pathogenic H5N1 viruses, we will gain knowledge which can be applied to selecting vaccine seed strain viruses in the future.

Key Words: Hemagglutinin, Vaccines, Avian influenza, HI test, Shedding

T92 Isolation and characterization of an avian influenza virus from a wild waterfowl. T. Dormitorio*, J. Giambrone, K. Guo, and G. Hepp, *Auburn University*, *Auburn, AL*.

Wild aquatic birds form the natural reservoir of avian influenza viruses, and have been implicated as a continuous source of virus for domestic birds as well as other animal species including humans. Through surveillance of wild birds, prevalence of avian influenza viruses (AIVs) can be monitored and the pathogenic and antigenic properties of the circulating viruses can be determined. Cloacal swabs were obtained from various species of wild, hunter killed or trap nested waterfowl on the Eufaula Wild Life Refuge in Southern Alabama. The samples were brought to the laboratory where they were processed for embryonated egg inoculation, hemagglutination, Directigen™ AC-ELISA, and real-time RT-PCR (RRT-PCR) tests. Samples positive for AIV, using all tests, were submitted to NVSL, Ames, Iowa for subtyping. Only one sample, S10706-26, which came from a Northern shoveler was positive for presence of AIV by all tests. It had an HA titer of 64 and allantoic fluid from a second, but not the first, egg passage produced a positive result by Directigen™ test. RRT-PCR showed that allantoic fluid from the inoculated egg was positive (Cp=24) for the matrix gene of AIV, but negative for the H5 and H7 genes. Allantoic fluid containing the positive AIV was sent to the NVSL and was determined to be of the H10N7 subtype. Additional molecular characterization of this H10N7 isolate is being conducted using cloning and sequencing of the H10 gene.

Key Words: Avian influenza, Waterfowl, Real-time RTPCR, AC-ELISA, Hemagglutination

T93 Protection against exotic Newcastle Disease virus (NDV) challenge of chickens vaccinated with NDV vaccines made from different genetic lineages. P. J. Miller*, C. Estevez, Q. Yu, D. L. Suarez, and D. J. King, *Southeast Poultry Research Laboratory*, *Athens, GA*.

Vaccines for control of Newcastle Disease (ND) have been used for over fifty years in the United States. The available ND vaccines, both live and killed have been shown to prevent mortality and symptoms of disease. However, they typically do not prevent vaccinated birds from becoming infected and shedding virus that may infect susceptible birds. The purpose of this study was to determine if vaccination with Newcastle Disease virus (NDV) strains that are genetically more similar to the challenge strain reduce the shedding of challenge virus. Two experiments were conducted using four-week-old specific pathogen-free Leghorn chickens. In the first experiment chickens were subcutaneously vaccinated with inactivated vaccines utilizing strains B1, Ulster, CA 2002, Pigeon 84, Alaska 196, or uninfected allantoic fluid as control. In the second experiment chickens were vaccinated with either live or inactivated vaccines using a recombinant Anhinga 1993 NDV with either its own hemagglutinin neuraminidase (HN) gene or with a HN substitution from CA 2002, a live B1 commercial vaccine, an inactivated challenge virus (CA 2002) vaccine, or appropriate control vaccines. Three weeks post-vaccination seroconversion was assessed by ELISA and hemagglutination inhibition (HI) assays performed against each of the vaccine antigens. After challenge with virulent CA2002, birds were examined daily and monitored at selected intervals for virus shedding. All treatments except for the sham vaccinated controls induced greater than 83% protection from clinical disease and mortality. More importantly, the vaccines homologous with the challenge virus reduced oral shedding significantly more than the antigenically heterologous vaccines. Consequently, vaccines formulated to be antigenically closer to circulating virulent viruses can provide better Newcastle Disease control by reducing virus transmission from vaccinated birds.

Key Words: Exotic Newcastle Disease, NDV, Inactivated vaccine, Live vaccine, Viral shed

T94 Infectious bursal disease viruses identified in Colombia, South America. L. Purvis*, P. Villegas, and F. Perozo, *University of Georgia*, *Athens*.

During 2005-2006, inactivated bursal imprints in FTA cards were obtained from Colombia for molecular identification of infectious bursal disease virus (IBDV) using RT-PCR and sequencing. Molecular analysis of the hypervariable region of VP2 containing amino acids 206 through 310 was conducted in order to determine the strain of IBDV. The samples were submitted from farms in Colombia experiencing problems with IBDV. Over half of the samples analyzed were classified as very virulent IBDV (vvIBDV), and the second largest group of samples corresponded to variant strains. The finding of the presence of vvIBDV and variant strains in Colombia is important to establish procedures to control these field strains.

Key Words: Infectious Bursal Disease, South America

T95 Characterization of infectious bursal disease virus RNA-dependent RNA-polymerase leads to higher viral titres in cell culture. T. Letzel[1], A. E. Gorbalenya[2], and E. Mundt*[3], [1]*Institute of Molecular Biology*, *Insel Riems, Germany*, [2]*Leiden University Medical Center*, *RC Leiden, The Netherlands*, [3]*University of Georgia, PDRC*, *Athens*.

Infectious bursal disease virus (IBDV) as a member of the family Birnaviridae contains a bisegmented genome of double-stranded RNA. The larger segment A encodes a polyprotein [viral proteins (VP) 2-4-3] and the viral protein VP 5. The smaller segment B encodes VP1 which represents the RNA-dependent RNA-polymerase (RdRp) of IBDV. VP1 was expressed fused to a His-tag employing a baculovirus system for investigation of the functionality of this protein. After purification by affinity chromatography VP1 was used in an in vitro RdRp assay using a mutated VP1 as control. VP1 showed in vitro RdRP activity whereas the mutant did not indicating that the RdRp activity was indeed caused by the presence of VP1. Further investigations using different divalent cations were performed to characterize the reaction conditions in vitro. It was observed that in presence of 5 mM Co2+ the efficiency of the reaction was 20-fold higher than in the presence of 5 mM Mg2+. To apply this finding to the improvement of virus production in cell culture appropriate experiments were performed. After optimization of the cell culturing conditions IBDV infection experiments were performed. The obtained results showed a significant increase of IBDV titres in the presence of 50 µM Co2+. This phenotype was observed independent from the used cell culture since in further experiments using a different bird cell line a signifcant increase of the viral titre was detected. This effect was observed to be IBDV specific since for the avian reovirus strain 1133 no significant differences were detected. This finding could help establishing a more efficient vaccine production of IBDV in cell culture.

Key Words: IBDV, RdRp, Replication, Titer, Vaccine

Tuesday, January 23, 2007
SCAD III (Avian Diseases)
Room B312

T96 Efficacy study of a live attenuated reovirus vaccine given by the *in ovo* route to SPF and commercial broilers. K. C. Cookson*[1] and J. J. Giambrone[2], [1]*Fort Dodge Animal Health*, *Overland Park, KS*, [2]*Auburn University*, *Auburn, AL*.

The efficacy of an attenuated reovirus vaccine was measured using a previously established reovirus challenge model. **Study design:** Broilers from a commercial flock (COM, breed A) and an SPF flock (breed B) were vaccinated *in ovo* with a full dose of HVT/SB-1 with or without a 1/5 dose of V.A. ChickVac (VAChVac). 20 chicks per flock were bled for reovirus Idexx ELISA. 120 chicks per flock were then housed 20 per Horsfall isolator. At 3 days of age (D3) a set of birds were challenged intratracheally (IT) with 4.0 logs10 (chick ID50) of malabsorption strain 2408. Another set were challenged at 5 days of age. At 16 days of age all groups were weighed. **Results:** Non-vaccinated COM broilers (NoVax rows, table below) were significantly lighter from challenge at 3 days (8.5%) and 5 days (25.7%). SPF-NoVax were lighter only after D3 challenge. V.A. ChickVac caused no weight suppression (NC columns). V.A. ChickVac completely protected both SPF challenge groups against weight suppression (D3 and D5 columns). The commercial flock was fully protected from the D3 challenge but there was only partial, but significant protection from D5 challenge. **Discussion:** The commercial flock was selected for its marginal levels of reovirus maternal antibodies (MAB). Previous challenge studies using this model have shown flocks near 1,800 geometric mean titer (GMT) are susceptible to D3 reovirus challenge. In this study, the D5 challenge resulted in even greater weight suppression, perhaps because there was less MAB protection at the time of challenge. The SPF flock had a similar level of weight suppression from D3 challenge; however, it was resistant to the D5 challenge. The MAB-negative SPF flock was expected to be more susceptible to early reovirus challenge. Perhaps the breed difference is responsible for the discrepancy seen here. **Summary:** The live attenuated reovirus vaccine was safely given *in ovo*, resulting in full protection in 3 of the 4 challenge groups and partial protection in the 4th, most heavily stunted group.

Table 1. 16-day body weights of broilers intratracheally challenged with reovirus strain 2408

Flock description	Hatch GMT	No-Reo BW	Challenge BW suppression	Challenge BW	at 3D BW suppression	Challenge BW	at 5D BW suppression
COM-NoVax	1,793	561a	NA	513b	8.5%	417d	25.7%
COM-VAChVac		588a		560a		474c	15.5%
SPF- NoVax	192	462b	NA	432c	6.5%	452b	02.2%
SPF-VAChVac		498b		470b		530a	

Challenge groups within a flock (i.e., COM) having a different letter are significantly different, based on Tuke's multiple range test ($P<0.05$).

Key Words: Reovirus, Vaccine, Protection, *In ovo*, Broilers

T97 Multiplex RT-PCR for the detection of astroviruses and rotaviruses in poultry. C. Stephens*, M. J. Pantin-Jackwood, and E. Spackman, *University of Georgia*, *Athens*.

Viral enteric diseases cause substantial economic loss to the US poultry industry because they lead to decreased weight gain, increased morbidity, increased mortality, and increased production costs from poor feed conversions and increased use of therapeutic anti-microbial treatments. Astroviruses and rotaviruses are among the most commonly detected viruses found in chicken and turkey intestinal samples. Two multiplex RT-PCR tests for the simultaneous detection and differentiation of four avian astrovirus types and avian rotaviruses from feces and intestinal samples from poultry were developed and validated. The multiplex RT-PCR for chicken samples detects Avian Nephritis Virus (ANV), Chicken Astrovirus (CAstV) and Rotavirus. The multiplex RT-PCR for turkey samples detects Turkey Astrovirus 1 (TAstV-1), Turkey Astrovirus 2 (TAstV-2), Avian Nephritis Virus (ANV) and Rotavirus. Assay detection limits for each virus were determined. An evaluation of different sampling times and types for each virus was performed with experimentally infected chickens and poults. The multiplex RT-PCR's developed were successfully used in a survey on enteric viruses circulating in poultry in the United States.

Key Words: Astrovirus, Rotavirus, Chicken, Turkey, Multiplex RT-PCR

T98 Ecology of reticuloendotheliosis virus (REV) in a closed population of captive endangered prairie chickens. T. M. C. Barbosa*, G. Zavala, and S. Cheng, *University of Georgia*, *Athens*.

Reticuloendotheliosis (RE) is a neoplastic and immunosuppressive disease of poultry. RE virus (REV) can be a contaminant of vaccines. Attwater's Prairie Chicken (APC) is an endangered avian species, partly due to enzootic REV infection. REVs were isolated from APCs housed at the Fossil Rim Wildlife Center (TX). In a previous study, one isolate (REV APC-566) experimentally induced delayed growth, mortality, and decreased egg production and hatchability in Japanese quail. It also caused tumors at early ages and the majority of tumors were classified as CD3+ Lymphosarcomas. Nucleotide and amino acid alignments of full genome showed that REV APC-566 is closely related to REV inserted into Fowlpox virus. In this study we examined the nucleotide and amino acid sequences of several APC REV isolates. REVs were isolated and propagated in DF-1 cells from whole blood or tumors from APCs. The proviral DNA was amplified with specific primes for the *env* gene and the LTR. These regions were aligned with REV sequences available at GenBank and other REV sequences also resolved in our laboratory. All APC REV LTR sequences showed highly conserved deletions and insertions in the U3 region. All known promoters and enhancers are also highly conserved. The *env* gene is well conserved, in contrast with other avian retroviruses. Similar to REV APC-566, other APC isolates from the same APC colony display high similarity with REV inserted into Fowlpox virus. An immunosuppressive peptide coding region within the transmembrane

region of env is highly conserved in all REV sequences examined. This immunosuppressive peptide is well described in mammalian in vitro systems and has been detected in mouse, feline, monkey and other retroviruses. Thus, REVs circulating in a closed colony of APCs are genetically stable. REV APC-566 caused impairment of immune responses in experimentally inoculated SPF turkeys. Functional assays are still needed to confirm the immunosuppressive properties of the putative REV immunosuppressive peptide.

Key Words: Reticuloendotheliosis virus, Attwater′s Prairie chicken, Sequencing, Immunosuppressive peptide, Fowlpox

T99 Effects of chicken anemia virus (CAV), infectious bursal disease virus (IBDV) and reovirus on cellulitis development in chickens. K. S. Macklin*[1], J. J. Giambrone[1], K. Cookson[2], and H. Toro[1], [1]*Auburn University*, *Auburn, AL*, [2]*Fort Dodge Animal Health*, *Lawrence, GA*.

E. coli derived cellulitis is a major problem in the broiler industry that costs the industry millions of dollars annually. In this experiment 72 broiler chickens were obtained from a commercial hatchery and randomly assigned into 6 Horsfall isolator units. Six treatments were used with no replication per pen. All birds had maternal antibody against all 3 viruses used in this study. The treatment 1 was the negative control (CON). In treatment 2 (VIR), the birds were administered CAV and reovirus at 3 days of age, and IBDV at 7 days of age. Treatment 3 (VHI) consisted of the 3 viruses mentioned in VIR and 0.1 ml of 4.7x108 *E. coli* administered subcutaneously in the breast at 25 days of age. Treatment 4 (VLO) was similar to treatment 3, except *E. coli* was administered at 4.7x105. Treatments 5 (LO) and 6 (HI) were not given a viral challenge, but were challenged at 25 days of age with *E. coli* at 4.7x105 and 4.7x108, respectively.

Of the 3 groups that received CAV, histopathology showed that there was atrophy of the thymus in 18% of VLO, 25% of VHO, but no signs of the virus were detected in VIR. CAV-PCR results show that the virus was present in some of the birds from all three viral challenge groups. All birds that were administered reovirus showed a 9% suppression in body weight compared to the non-reovirus challenged birds. All 3 of the IBDV challenged treatments had approximately 90% bursal atrophy. None of the non-viral challenged treatments showed thymic or bursal atrophy and their body weights were similar to CON. Among the *E. coli* challenged treatments, the 2 high dose groups had 91% and 75% incidence of cellulitis in the HI and VHI groups, respectively. Of the two low dose groups only VLO had positives at 36%. As was observed with the viruses, there were no cellulitis lesions in non-*E. coli* challenged birds. The addition of immunosuppressive viruses did not effect the development of cellulitis lesions in the high dosed birds; however in the low dosed birds the addition of the viruses increased the likelihood of cellulitis development.

Key Words: Cellulitis, *E. coli*, CAV, IBDV, Reovirus

T100 Evaluation of the tissue tropism and transmission of the tissue culture origin (TCO) live-attenuated vaccine of infectious laryngotracheitis virus. A. Rodriguez* and M. Garcia, *University of Georgia*, *Athens*.

The protection ability and safety of the ILTV TCO live-attenuated vaccine has been widely studied, however the tropism and transmission of the TCO vaccine has not been well documented. The aim of this study was to determine the target organs where the vaccine replicates, and the ability of the vaccine to transmit to unvaccinated birds in close proximity. Four weeks old specific pathogen free (SPF) chickens were vaccinated by eyedrop with the TCO vaccine. Unvaccinated SPF chickens were housed in direct contact to vaccinated chickens since first day of vaccination. Virus isolation and real time PCR were used to detect the presence of live virus and viral DNA, respectively, in the trachea, trigeminal ganglia, eyelids swabs, cecal tonsils, and cloacal swabs at interval days postvaccination (2, 4, 5, 6, 7, 8, 9, 10, 14, 18, 21, 24, and 28) from vaccinated and contact-exposed birds. The virus was isolated from trachea at day 9 post vaccination from both vaccinated and unvaccinated birds, and from eyelid swabs at 4, 6, 7, and 9 from vaccinated birds, and at 7 and 9 days from unvaccinated birds. Virus was not isolated from the trigeminal ganglia, cloacal swabs, and/or cecal tonsils at any of the time points. Viral DNA was detected from eyelid swabs from day 2 to 14, from trachea at days 4, 5, 6, 9, and 10, and from trigeminal ganglia at days 5, 6, 7, and 9. Real time PCR analysis of cecal tonsils, cloacal swabs and other samples collected at 18, 21, 24, and 28 days post vaccination is ongoing. Replication of the TCO vaccine in the eyelid and the trachea, as well as the transmission from vaccinated to unvaccinated birds was demonstrated.

Key Words: Infectious laryngotracheitis, Tropism, Transmission, Real time PCR, Virus isolation

T101 A natural challenge model for ILTV laboratory studies. J. Giambrone*, S. Fagbohun, and K. Macklin, *Auburn University*, *Auburn, AL*.

Infectious laryngotracheitis virus (ILTV) is an economic problem in broilers reared in concentrated areas. A natural exposure (challenge) model was needed to test the efficacy of commercial litter treatments, which are used to reduce ILTV exposure. The ILTV challenge model was developed by seeding pine shavings with commercial ILTV vaccine. This was done by serial back passage of vaccine virus in SPF chickens. The back passage was started by vaccination of four, 3-week-old broilers with 10 doses each of live vaccine by eye and nasal instillation. Birds were placed on litter in Horsfall-Bauer units. At 1 week later birds showed slight respiratory signs (sneezing and conjunctivitis) typical of silent or vaccine induced ILTV. Three more 4-week-old sentinel birds were added to the same units. At 1 week later contact exposed birds showed minor respiratory signs. At this time the initially vaccinated birds were killed and examined post-mortem. Their trachea were taken for microscopic observation and tested for ITLV DNA using a newly developed nested PCR. Another group of 3, 3-week-old sentinel birds were added to the contaminated unit, containing the remaining infected birds. At a week later, these birds also developed minor clinical respiratory signs. At this time all birds were killed and examined. All birds had slight congestion in the trachea or conjunctivitis, and mild microscopic lesions in the trachea suggestive of respiratory distress. A piece of each trachea was pooled from all groups and all were positive for ILTV DNA by the nested PCR test. This contaminated litter was taken to an isolated block house, to be exposed to various litter treatments for 5 days. After this treatment, the litter was returned to the units and 9, day-old birds were again placed on the litter to see if the became infected with ILTV at 3, 4 or 5 weeks of age. Three, SPF birds placed on the positive non-treated

litter were negative for ILTV DNA at 3 weeks of age. However, the additional birds placed in the same unit at day of age, which were tested at 4 or 5 weeks of age, were positive for ILTV DNA. This ILTV challenge model has proved useful for testing the efficacy of litter treatments.

Key Words: ILTV, Challenge, Litter, Treatments

Tuesday, January 23, 2007
Nutrition III
Room: 313

T102 Effect of a new coating on the thermotolerance and bioefficacy of a phytase product in broilers fed corn-soybean meal-based diets. A. Owusu-Asiedu[1], J. C. Remus*[1], P. H. Simmins[1], and R. Croxall[4], [1]*Danisco Animal Nutrition*, *Marlborough, Wiltshire, United Kingdom*, [2]*Danisco Animal Nutrition*, *St. Louis, MO*, [3]*Danisco Animal Nutrition, Marlborough*, *Marlborough, Wiltshire, United Kingdom*, [4]*ADAS, Gleadthorpe*, *Mansfield, Nottinghamshire, United Kingdom*.

A study evaluated the effects of a new coating (C) on thermal tolerance and bioefficacy of a bacterially-derived, phytase product (Phyzyme XP; 6-phytase, EC 3.1.3.26) in broilers fed corn-soybean meal-based diets. 1440 male Ross 308 chicks were assigned to six dietary treatments (1-6) with eight replicates pens each (30 chicks/pen). The treatments were: 1. Positive control (PC), 2. Negative control (NC), 3. NC + 500 U/kg phytase, 4. NC + 500 U/kg C phytase, 5. NC + 500 U/kg C phytase pelleted at 80°C, and 6. NC + 500 U/kg C phytase pelleted at 90°C. All the diets were formulated to be isocaloric and isonitrogenous. The Ca and available P levels were 0.90% and 0.37% in PC and 0.78% and 0.26% in NC diets, respectively. Birds were weighed on days 0 and 21, and two birds from each pen were randomly selected and sacrificed on day 21. The left tibia was removed and dry defatted ash determined. Birds fed PC diet and diets supplemented with phytase were heavier (P<0.05) at day 21 than birds fed NC diet. Birds fed C phytase supplemented diets and pelleted at 80°C and 90°C were heavier (P < 0.05) at day 21 and had a better FCR (P<0.05) than birds fed the PC diet. Birds fed the NC diet consumed less (P<0.05) feed than birds fed the PC or phytase supplemented diets. Tibia ash was lower (P<0.05) for birds fed the NC diet compared to all other treatments. In conclusion, a new coating applied to the phytase achieved thermostability up to 90°C while demonstrating similar bioefficacy to the uncoated phytase.

Key Words: Enzymes, Phytase, Pelleting, Broiler, Thermostability

T103 Coating for pellet stability does not adversely affect the phosphorus-releasing efficacy of an *E. coli*-derived phytase in young chickens. N. R. Augspurger[1], S. D. Frankenbach*[1], T. J. Applegate[2], J. S. Moritz[3], F. Ruch[1], and D. M. Webel[1], [1]*JBS United, Inc.*, *Sheridan, IN*, [2]*Purdue University*, *West Lafayette, IN*, [3]*West Virginia University*, *Morgantown*.

The phytase enzyme is highly susceptible to inactivation by heat and moisture, conditions encountered during pelleting. Alternatively, phytase can be applied as a liquid to the pellet, by-passing the high heat and moisture, or the dry phytase can be stabilized to retain a high proportion of activity and added prior to pelleting. A series of trials was done with an *E. coli*-derived phytase (OptiPhos™, JBS United, Inc.) to determine the effect of adding a lipid coating to the phytase particle on the pellet-stability, as well as its *in vivo* phosphorus (P)-releasing efficacy in chickens. For each of the pelleting trials, corn-SBM diets containing 1,000 FTU/kg phytase, from either uncoated or coated preparations, were pelleted at 85°C following 60 s of mixing with steam. Samples of feed were taken pre- and post-pelleting and analyzed for phytase activity; retention values were then calculated. Three chick assays utilized standard-curve methodology to compare the P-releasing efficacy of both uncoated and coated phytase. In each assay, four pens of four or six male broilers were fed P-deficient experimental diets supplemented with inorganic P or phytase from either uncoated or coated preparations for 11-14 d, after which tibia were collected for determination of bone ash (mg and %). The first chick assay showed no effect ($P > 0.10$) of the coating on the P-releasing efficacy of an *E. coli*-derived phytase at 500 FTU/kg (0.14% P); the coated phytase retained 76 ± 6 (SD)% of its activity after pelleting at 85°C (32 ± 10% for uncoated). The addition of the coating to the phytase in the second chick trial did not affect ($P > 0.10$) the P-releasing efficacy, and resulted in a phytase retention value of 82 ± 13% after pelleting at 85°C. The third assay revealed P-releasing efficacy estimates of 0.128 and 0.133% for 500 FTU/kg of the uncoated and coated phytases, respectively ($P > 0.09$). These data show that adding a lipid-based coating to phytase is efficacious for stabilizing the phytase in the pelleting process at 85°C, and does not adversely affect the quantitative efficacy in chickens.

Key Words: Phytase, Phosphorus, Broilers, Pelleting, Stability

T104 Quantum™ phytase exhibits high specific activity and high substrate affinity over the full gastric pH range. A. Nelson*[1,2], S. S. Basu[1,2], and S. Betts[1,2], [1]*Syngenta Biotechnology, Inc.*, *Research Triangle Park, NC*, [2]*Syngenta Animal Nutrition*, *Research Triangle Park, NC*.

Phytin in bird feed is solubilized in the acidic environment of the upper gastrointestinal tract, releasing phytate and mineral cations. However the release of phytate is reversible such that as the pH increases, for example as feed digesta move from the gizzard into the small intestine, phytate can again chelate soluble cations to form insoluble phytin. For this reason phytases used to supplement bird feed must be active in the acidic pH range where phytate is soluble and biologically available. The region of highest phytate solubility - and hence susceptibility to enzymatic hydrolysis - is therefore the upper digestive tract from the crop to the duodenum.

In this in vitro study the catalytic properties of an Escherichia coli-derived phytase, Quantum™ phytase, were examined side-by-side with two commercially available fungal phytases at a series of

physiologically relevant pH conditions. The plot of specific activities (μ mol phosphate released/min/mg protein measured at 37°C) vs. reaction pH showed that compared to fungal phytases Quantum phytase catalyzes phytate hydrolysis at a very fast rate over a broad range of acidic pH-conditions (as low as pH 1.5). By contrast, the fungal phytases exhibited much lower specific activities and were more sensitive to acidic pH conditions. The substrate affinity (apparent Km values) of each phytase was also determined from double-reciprocal plots of the reaction rate at varying phytate-substrate concentrations. Quantum phytase was found to have comparable Km values at all physiologically relevant pH conditions tested (pH 2.5, 4.5 & 5.5). These results demonstrate that Quantum phytase is a highly efficient catalyst for phytate-phosphate hydrolysis and an attractive candidate for use as a feed additive enzyme.

Key Words: Phytate, Phytase, Kinetics, pH-profile, Acidic

T105 Effects of buffer types and concentrations on phytase product analysis. S . Dalsgaard*[1], C. Gilbert[2], and R. Lorentsen[1], [1]*Danisco Innovations*, *Brabrand, Denmark*, [2]*Danisco Animal Nutrition*, *Marlborough, Wiltshire, United Kingdom*.

Phytase is used in feed to improve phytate phosphorus digestibility. Commercial phytases are either fungal or bacterial in origin. The feed industry needs a robust assay to measure phytase in products, in premixes and in feed. Ideally, this assay needs to be appropriate for all commercial phytases. To get a better understanding of phytase functionality, a study of two commercially available bacterial origin phytases was carried out to assess how each phytase reacted under different assay buffer conditions. Phytase is described based on the phytase unit (FTU) wherein 1 unit is defined as the amount of enzyme needed to liberate 1 micromole of inorganic phosphate from sodium phytate per minute at pH 5.5 and 37°C. The buffer system used to achieve this pH can vary and potentially could influence the number of phytase units measured. This study used different molarities of acetate and citrate buffers, both of which have been used in published assay methods for phytase. Also, two different colour reagents used in phytase assays were compared to assess their impact on the activity measured. Phytase activity was measured at pH 5.5 and 37°C as per the standard definition of a phytase unit (FTU). The colour reagents did not affect measured activity in the phytases. Changing the buffer from a 0.25M acetate buffer to a 0.2M citrate buffer reduced the assayed activity by approximately 50%. Use of a 0.1M citrate buffer increased the activity measured compared to the 0.2M citrate buffer, but the activity was still 15-20% less than with acetate buffer. Measured activity (FTU) is therefore significantly influenced by assay buffer within the same unit definition. In conclusion, this study shows that it is incorrect to assume that products containing a specified number of phytase units (FTU) are directly equivalent without seeing detail of the assay methodology. For this reason it is always necessary to standardise phytase units using one method before running, or interpreting, comparative bioefficacy studies.

Key Words: Enzymes, Phytase, Assay, Buffers, Activity

T106 Kinetics of phytase-catalyzed sequential hydrolysis of inositol phosphates: Can this be a criterion to differentiate among phytases used in poultry diet? R. Prata*[1,2], C. Batie[1,2], S. Betts[1,2], and S. S. Basu[1,2], [1]*Syngenta Biotechnology, Inc.*, *Research Triangle Park, NC*, [2]*Syngenta Animal Nutrition*, *Research Triangle Park, NC*.

Supplementation of poultry feed with exogenous phytase is viewed as essential to liberate trapped phosphate from phytate (inositol hexakisphosphate; IP_6). In addition, phytases have indirect nutritional benefits. Phytate is an anti-nutrient: its metal chelating activity decreases the bioavailability of minerals as well as the digestibility of starch and protein. Thus, phytase also reduces the anti-nutritive effects of phytate. It has also been proposed that the chelating power and capacity of phytate markedly decreases upon removal of two phosphates to form inositol tetrakisphosphate (IP_4).

Studies were conducted to investigate the kinetics of the phytase-catalyzed sequential conversion of IP6 to inositol phosphate reaction intermediates, IP_5 and IP_4, using the E. coli derived Quantum™ phytase (a 6-phytase) and two commercial fungal phytases (one 6-phytase & one 3-phytase). The objective of these experiments was to identify possible differences in the rates of IP_6 and IP_5 depletion by these phytases. Experiment set 1, all phytase reactions were performed using equal doses of enzyme activity measured in standard unit (FTU, assayed at pH 5.5 & 37°C). The concentrations of IP_6, IP_5 and IP_4 were measured over time in reactions carried out at pH 2.5 and 3.5 with 100% IP_6 as the substrate. Under these conditions Quantum phytase depleted the anti-nutrients IP_6 & IP_5 at a significantly faster rate than the two fungal phytases. In experiment set 2 similar reactions were performed but using equal phytase activity, this time measured at the pH of the reaction (pH 2.5 & 3.5). Development of kinetic models and comparison of the rate constants of IP_6, IP_5 and IP_4 hydrolysis catalyzed by these phytases show that Quantum phytase is more efficient in converting IP_6 to IP_4 over the full range of physiologically relevant pH conditions. Based on the above described catalytic properties of phytases, it may be predicted that Quantum phytase can be highly effective in neutralizing the anti-nutritive properties of phyate in poultry diet.

Key Words: 6-phytase, 3-phytase, Reaction mechanism, Inositol phosphate, Rreaction intermediates

T107 The effect of exogenous phytase on performance, dietary energy, mineral metabolism and endogenous losses when different protein sources are fed to chicks. V. Pirgozliev*[1], T. Acamovic[1], S. Sarwar[1], M. Allymehr[1,2], and M. R. Bedford[3], [1]*Scottish Agricultural College, ASRC*, *Edinburgh, United Kingdom*, [2]*Urmia University, FVM*, *Urmia, Iran*, [3]*Syngenta Animal Nutrition Inc.*, *Marlborough, Wiltshire, United Kingdom*.

An experiment (5*3 factorial) was designed to investigate the effects of different concentrations of an evolved E. coli derived phytase (Quantum, Syngenta Animal Nutrition) and three different protein sources on performance, dietary energy, N and mineral metabolism when fed to young chickens (from 7 to 21d of age). Four hundred and fifty male Ross 308 chicks were allocated in a randomised block design to one of the six replicate cages (5 birds per cage) and fifteen experimental diets (positive control (PC), negative control (NC), NC + 250, + 500, + 12500 FTU (phytase units/kg feed). The diets included rapeseed meal (RSM), soybean meal (SBM) or sunflower meal (SM) as the main protein source. Birds fed enzyme supplemented diets

had improved performance (P<0.05) compared to those fed negative control diets. Chicks had higher feed intake, gain and gain:feed ratio (P<0.001) when the protein source in the diet was either SBM or SM, compared to the RSE. Although phytase did not affect (P>0.05) dietary metabolisable energy (ME) and dry matter digestibility (DMD), SBM supplemented diets had higher ME (P=0.042), metabolisability of gross energy and DMD coefficients (P<0.001) compared to the two other protein sources. Birds fed RSM had higher (P<0.001) endogenous losses, measured as sialic acid. Birds fed RSM also had lower Ca, P (P<0.001) and Mg (P<0.05) metabolisability coefficients compared to SBM and AM. The lower coefficient (P<0.001) of S metabolisability of RSM indicates that the S-containing amino acids were also less available compared to those from SBM and SM. The data from the present study suggests that the phytate in rapeseed may be less susceptible to phytase degradation compared to phytate in the other two sources and indicates that phytase supplementation of diets needs to be adjusted depending on the ingredients used in the diets.

Key Words: Phytase, Rapeseed solvent extract, Soybean, Sunflower, Chicks performance

T108 Assessment of the efficacy of quantum phytase and a fungal phytase on the performance of broilers fed a maize-based diet deficient in available phosphorus. T. C. Murphy* and M. R. Bedford, *Syngenta Animal Nutrition*, *Research Triangle Park, NC*.

A 42d pen trial consisting of 8 replicates of 30 male Ross broilers, randomly assigned to 1 of 9 dietary treatments, was conducted to study the effects of various levels of a bacterial phytase, Quantum™ 2500D (QP) on the performance of broilers compared to a constant level of a fungal phytase (FP). The treatments were: a corn/soybean meal positive control (PC) formulated to meet or exceed NRC requirements, a negative control (NC) with 0.12% and 0.16% less non-phytate phosphorus in the starter (0-21d) and finisher (21-42d) respectively, NC plus QP added at a rate of 125, 250, 500, 750, 1000 or 2000U/kg and NC plus FP added at a rate of 500U/kg. Gain, intake and FCR were analysed by ANOVA with mean separation using the LSD method at the 5% level. The reduction in dietary phosphorous significantly depressed gain and intake at both 21 and 42d but did not alter FCR. All doses of QP significantly improved gain at 21 and 42d. During the 0-21d period the 2000U/kg dose of QP was the only inclusion rate that was capable of increasing gain to levels not significantly different from the PC. By 42d birds fed diets supplemented with QP doses of 750U/kg and above had weight gains equivalent to that of the PC. The FP failed to show any positive effect on gain during either period, in fact it appeared to suppress gain from 0-21d. Supplementation of the NC with 250U/kg or above of QP increased intake. Whilst the lowest dose of QP was unable to offer any benefit upon addition to the NC in terms of intake, it still resulted in birds consuming significantly more than that observed for the 500U/kg of FP. No dose of QP restored intakes to that of the PC; however, since weight gain achieved parity at 750U/kg this meant that FCR was better for treatments having at least 750U/kg, relative to the PC. No difference was noted between 500U/kg of QP and the same dose of FP for FCR. This study further validates that QP, a bacterial derived phytase, can support performance when dietary phosphorus is limiting, in contrast to the FP source.

Key Words: Phytase, Quantum, Performance, Maize, Broiler

T109 Effects of dietary calcium and phytate on phosphorus retention and the optimal ratio of calcium to non phytate phosphorus in broiler diets. P. W. Plumstead*[1], A. B. Leytem[2], J. W. Spears[3], R. O. Maguire[4], P. Kwanyuen[5], and J. Brake[1], [1]*North Carolina State University*, *Raleigh*, [2]*USDA-ARS*, *Kimberly, ID*, [3]*North Carolina State University*, *Raleigh*, [4]*Virginia Tech*, *Blacksburg*, [5]*USDA-ARS*, *Raleigh, NC*.

The effect of reduced dietary phytate phosphorus (P) from soybean meal (SBM) on the ratio of calcium (Ca) to non phytate P (NPP) required for optimal retention of phosphorus (P) was investigated. Ross 508 broiler chicks were reared in battery cages to 14 d of age and fed one of 12 experimental diets from 15 to 20 d. Excreta or ileal digesta were collected from 18-19 d and at 20 d of age, respectively, and apparent ileal digestibility coefficients and overall retention of Ca and P and excretion of Ca, P, and phytate P calculated. A 4 x 3 factorial treatment structure was used with 4 levels of dietary Ca from 0.47% to 1.16% and 3 levels of phytate P of 0.27%, 0.23%, and 0.10% that were obtained by including either High, Conventional, or Low phytate SBM in diets. Apparent prececal P digestibility decreased when dietary Ca was increased and was higher when diets contained Low phytate SBM. The percentage phytate disappearance from the distal ileum decreased at high inclusions of Ca but was not different between diets containing High or Low phytate SBM. Inclusion of Low phytate SBM reduced excreta P output by 42% and 62% compared to broilers that had been fed either conventional or High phytate SBM, respectively. The ratio of Ca:NPP that resulted in the highest P retention and lowest P excretion was 2.53:1, 2.40:1, and 2.34:1 for diets with 0.27%, 0.23%, and 0.10% phytate P. This suggested that while increased dietary Ca reduced the extent of phytate hydrolysis, the optimum Ca:NPP ratio at which P retention was maximized was not greatly altered when Low phytate SBM replaced High phytate or Conventional sources of SBM in broiler diets.

Key Words: Broiler, Phosphorus, Soybean meal, Phytate, Environment

T110 The requirement of Zn provided as organic Zn for broiler chicks fed corn-soy based diet with or without supplementation of phytase. T. Ao*, J. L. Pierce, A. J. Pescatore, A. H. Cantor, K. A. Dawson, M. J. Ford, and B. L. Shafer, *Alltech-University of Kentucky Nutrition Research Alliance*, *Lexington, KY*.

A study was conducted to investigate the requirement of Zn when provided as Bioplex Zn® (a chelated Zn proteinate) for broiler chicks fed a practical corn soybean meal diet (25 mg/kg Zn content) with or without supplementation of phytase. One-day-old male broiler chicks were housed in starter cages with plastic covered feeders in an environmentally controlled room for 3wk. Birds were given *ad libitium* access to feed and regular tap water with no detectable Zn (<0.001 ppm). A 2 x 6 factorial treatment structure was used with two levels of phytase (0 or 500 U/kg) and six levels of Bioplex Zn® providing 0, 2, 4, 8, 16 and 32 mg Zn/kg. A total of 864 chicks was randomly assigned to each of twelve dietary treatments with six replicate cages of 12 chicks. Dietary inclusion of phytase increased (P<0.01) the feed intake, weight gain, plasma Zn and tibia Zn content. Dietary supplementation of Bioplex Zn® linearly (P<0.01) increased the feed intake, weight gain, plasma Zn concentration, liver Zn concentration and tibia Zn content. Significant interaction effects (P<0.05) of phytase and Bioplex Zn® on the feed intake and weight

gain were found. When the supplemental level of Zn was below 8 mg/kg, the dietary inclusion of phytase increased (P<0.05) feed intake and weight gain of the chicks. One slope, straight broken-line analysis of weight gain regressed on the supplemental Zn level provided as Bioplex Zn® indicated that 12 mg/kg supplemental Zn without phytase and 7.4 mg/kg supplemental Zn with phytase were required for the maximal weight gain of chicks.

Key Words: Chick, Zinc, Organic zinc, Phytase, Requirement

T111 Influence of betaine supplementation at different levels of dietary protein in diets on performance, blood composition and hepatic amino acid concentration in laying hens. K. S. Ryu* and J. H. Park, *Chonbuk National University*, *Chonju, South Korea*.

The effects of betaine intake on performance, internal egg quality, blood component and hepatic amino acid concentration were examined in laying hens fed diets at different levels of protein. A total of 540 Hy-Line Brown laying hens were allotted to six treatments with five replications for twenty four weeks. Treatments were factorially designed with three levels of CP (14, 16 and 18%) and two levels of betaine (0 and 600ppm). Egg production, egg mass and feed conversion improved as increase dietary protein level (p<0.05), but different from betaine supplementation. Eggshell breaking strength, eggshell thickness and haugh unit were not influenced by either supplementary betaine or the level of protein. Serum albumin concentration was significantly elevated in 18% protein-fed groups compared to those fed on the other protein-fed groups (p<0.05). Supplemental betaine did not affect serum total protein, albumin and BUN concentration, whereas uric acid concentration significantly increased in betaine supplemental groups (p<0.05). Concentrations of hepatic amino acids were influenced by increased protein-fed groups and dietary betaine supplementation. These results suggest that betaine does not increase in laying henÃ¢â‚¬â„¢s performance, but may affect protein metabolism by change in serum uric acid and hepatic amino acids.

Key Words: Betaine, Performance, Hepatic amino acid, Blood composition, Laying hens

T112 Versazyme additive improved growth performance, amino acid digestibility, and intestinal proteolytic activity in broiler chickens. H. Y. Wang[1,3], W. C. Huang[1], J. J. Wang[2], Y. M. Guo[3], and J. C. H. Shih*[1], [1]*North Carolina State University*, *Raleigh*, [2]*BioResource International*, *Morrisville, NC*, [3]*China Agricultural University*, *Beijing, China*.

Effects of dietary supplementation of Versazyme, a keratinase based feed additive, on growth performance, ileal amino acid digestibility and intestinal proteolytic activity were studied in broiler chicks fed corn-soy diets for 3 wks from d 1 to d 21. A total of 144 male broiler chicks were randomized to 2 treatments with 9 replicate pens per treatment. Digesta samples from different gastrointestinal segments (crop, gizzard, duodenum, jejunum, ileum) were collected at d 12 and d 21. Keratinase identity was analyzed by immunoblot and total proteolytic activity based on substrates specific for trypsin, chymotrypsin and keratinase was determined respectively. The amino acid digestibility was determined amino acid analysis in the digesta collected from the terminal ileum with celite as the undigested marker. Versazyme at 0.1% supplementation rate significantly improved average daily gain (ADG) (44.40 vs. 42.35 g, P<0.01) and feed conversion ratio (FCR) (1.24 vs. 1.28, P<0.01). It also significantly increased ileal amino acid digestibility. In addition, intestinal proteolytic activity was increased by 60% as measured by trypsin substrate (40 vs. 25 u/g protein) and by 66% as measured by the chymotrysin substrate (5 vs. 3 u/g protein). The 60-66% increase of activity could be contributed by the additional keratinase activity in the Versazyme in feed and in the intestine, because keratinase is active on a wide range of substrates including the trypsin- and chymotrypsin-specific substrates. The results of this study confirmed that dietary supplementation of Versazyme improved the growth of broiler chicks. Its beneficial effect is believed to be due to the improved protein digestibility as evidenced by the increased amino acid digestibility, proteolytic activity and the presence of keratinase in the intestine.

Key Words: Versazyme, Keratinase, Ileal amino acid digestibility, Proteolytic Activity, Immunoblot

T113 Efficacy of dietary clay adsorbents for broiler chicks fed aflatoxin (AFB1). R. B. Shirley*, F. A. Uraizee, C. D. Knight, and J. J. Dibner, *Novus International, Inc.*, *St. Louis, MO*.

The objective of this study was to determine the efficacy of the adsorbents SOLIS™-Base (SB) and MTB-100® (MTB) in ameliorating the toxic effects of aflatoxin (AFB1) in broiler chicks. Two hundred seventy five day-old male broiler chicks were assigned to one of eleven treatments (5 chicks/pen; 5 pens/treatment): 1) Control (no binder or AFB1); 2) 1 ppm AFB1; 3) 2 ppm AFB1; 4) 1 ppm AFB1 + 0.1% SB; 5) 1 ppm AFB1 + 0.2% SB; 6) 1 ppm AFB1 + 0.1% MTB; 7) 1 ppm AFB1 + 0.2% MTB; 8) 2 ppm AFB1 + 0.1% SB; 9) 2 ppm AFB1 + 0.2% SB; 10) 2 ppm AFB1 + 0.1% MTB; 11) 2 ppm AFB1 + 0.2% MTB. Body weight gain (BWG, ± sd) was reduced from 817 ± 26 to 732 ± 93 and 642 ± 92 g/chick, feed intake (FI, ± sd) was reduced from 1,045 ± 62 to 919 ± 100 and 753 ± 116 g/chick, and liver weight also increased from 2.71 ± 0.21 to 3.20 ± 0.36 and 4.45 ± 0.81 g/100 g BW with the addition of 0, 1 and 2 ppm AFB1, respectively (p ≤ 0.0001). Marked differences in the response of broilers to SB and MTB were apparent at the two levels of aflatoxin, as there was an interaction between binder type and AFB1 level. Though there was no difference in the average BWG among broilers consuming 0.1 and 0.2% SB or MTB at 1 ppm AFB1, there was an improvement in the average BWG of broilers consuming 0.1 and 0.2% SB at 2 ppm AFB1 (p ≤ 0.05). A similar interaction was also observed for average liver weight of broilers for the two binders at the two AFB1 concentrations (p ≤ 0.02). Increasing levels of AFB1 depressed plasma albumin, protein, calcium, phosphorus, and alkaline phosphatase (p ≤ 0.01). Despite the use of SB and MTB, only a numerical improvement in the concentration for many of the latter biomarkers was noted. In the present study, these data indicate that SB is more efficacious than MTB in mitigating the negative effects of high dietary AFB1.

Key Words: Aflatoxin, Adsorbent, Broiler Chick, SOLIS™-Base, MTB-100®

T114 Impact of ochratoxin A and deoxynivalenol on selected immune parameters in broiler chicken and possible counteracting. V. Starkl*[1] and H. Sarandan[2], [1]*Biomin GmbH*, *Herzogenburg, Austria*, [2]*Faculty of Veterinary Medicine*, *Timisoara, Romania*.

This trial was performed to evaluate the impact of a combination of 500ppb ochratoxin A and 1000ppb deoxynivalenol on selected immune parameters and the effect of Mycofix® Plus counteracting immune suppression via enzymes and specific immune supportive substances.

216 day old chickens (males and females) were randomly chosen and divided into 4 treatments. Birds in treatment 1 (T1) were fed a mycotoxin free diet. Treatment 2 (T2) consisted of a diet contaminated with 500ppb ochratoxin A and 1000ppb deoxynivalenol. Diet of treatment 3 (T3) was equally contaminated as T2 but additionally treated with 1 kg of Mycofix® Plus. Treatment 4 (T4) only contained 1 kg of Mycofix® Plus. After 42 days blood samples were taken from 3 males and 3 females per treatment for hematological and immunological examination. Levels of lysozime and properdin were selected as humoral factors. Levels of neutrophils, monocytes and eosinophils as well as the activity of macrophages as phagocytic index represent the cellular factors. Properdin and lysozime concentration in blood serum and the phagocytic index can be characterized as indicators for the level of natural immunological reactivity. Levels of lysozime were significantly lower in T2 in both females and males compared to T1 and T4. In females the use of 1,0 kg of Mycofix® Plus (T3) brought the levels back to normal. Properdin levels in T2 are significantly lower than those of treatments 1, 3 and 4, both for females and males. Natural cellular defense expressed, as phagocytic index was significantly lower in T2 compared to the other treatments 1, 3 and 4. Additionally, levels in T4 (sole product) were significantly higher than in the control T1, indicating the capacity of the product to stimulate the activity of macrophages. Levels of hematological parameters were inconclusive.

As a conclusion it can be stated that the selected contamination had a significant impact on levels of lysozyme, properdin and phagocytic index which was overcome by the inclusion of Mycofix® Plus.

Key Words: Ochratoxin A, Deoxynivalenol, Immune systeme, Broiler, Deactivation

T115 High *in vivo* mycotoxin binding efficacy of anti-caking aid restores immune function and improves broiler performance. V. J. H. Sewalt, A. Lamptey, P. Maheswari, S. Wilson*, and C. N. Ramchand, *Kemin Industries, Inc.*, *Des Moines, IA*.

A 35-day dose response performance trial was conducted to evaluate the impact of graded levels (1, 2, 3, and 4 kg/ton) of TXN-86™ $_{brand}$ Dry Anti-Caking Aid (Kemin AgriFoods North America, Inc.) on weight gain and feed conversion of VenCobb broiler birds fed a corn-soy-fishmeal diet containing a mycotoxin cocktail consisting of aflatoxin, ochratoxin, citrinin, and T-2 toxin. Weight gain and feed conversion were negatively impacted by the exposure to mycotoxins ($P \leq 0.001$). Addition of TXN-86 reversed ($P \leq 0.001$) the negative effects of mycotoxins in a linear dose response, returning performance to levels achieved by birds in the positive control group (no toxin) with the 3-4 kg/ton application rates.

Relative organ weight was increased by ingestion of mycotoxin, which, again, was overcome with the inclusion of the Anti-Caking Aid TXN-86 ($P \leq 0.001$). While no discernible relationship was evident for mycotoxins and serum biochemistry parameters, NCD virus-specific immune response depression in birds receiving mycotoxins was reduced with increasing doses of TXN-86, with birds receiving the highest dose having HI titer values equivalent to those of positive control birds ($P \leq 0.001$). Fecal excretion data indicated increased excretion of all toxins in birds receiving increasing doses of TXN-86 ($P \leq 0.001$) in a linear or quadratic manner, along with highly positive correlations between the amounts of mycotoxin excreted and weight gain. Hence, the improved performance and immune response closely reflects the *in vivo* mycotoxin binding capacity of TXN-86 Anti-Caking Aid and also validates the *in vitro* assay results previously presented at this forum.

Key Words: TXN-86, Mycotoxins, Toxin binder, Performance, Excretion

T116 Preliminary assessments of flo-bond as toxins inhibitor and preservative in animal feeds. A. M. Raji*, R. A. Salako, A. O. Owosibo, and J. A. A. Sansi, *Federal College of Animal Health and Production Technology*, *Ibadan, Nigeria*.

Mycotoxins and other forms of anti-nutritional factors are major limitations in the production of quality animal feeds in the humid tropics of the world, Nigeria inclusive.

Four different poultry feed of 1kg each was used for the investigations; the samples of the feeds were commercially purchased from four different feed mills in and around Ibadan, Oyo State, Nigeria. The samples were properly prepared and labeled A to H with each part containing 250g. 0.025g of Flo-bond powder was added to categories A, B, C and D that served as treatment samples, while categories E, F, G and H served as control samples (without Flo-bond). The feed samples were sealed in cellophane bags and then observed for the period of 3 weeks as ripening period.

Microbial analysis was conducted and monitored over the ripening period, on the different feed categories to determine the bacteria as well as fungal counts of the samples. Sample F had the highest bacterial count; while C had the least bacteria count. For the fungal count, sample A had the highest, while samples C, E and H recorded no fungal count.

There was no significant difference in fungal count ($P>0.05$) but a significant difference in bacteria count ($P<0.05$). Those samples with Flo-Bond had growth of fungi which capable of producing toxins, unlike those that are without Flo-bond powder. Thus, Flo-bond can be regarded as an effective feed preservative as well as toxin binder in animal feeds. A further study on the actual utilization of Flo-bond in on farm trial is hereby recommended.

Key Words: Mycotoxins, Feeds, Flo-bond, Bacteria, Fungus

Tuesday, January 23, 2007
Environment and Management IV
Room: B314

T117 Laboratory evaluation of advance bio-pro concentrate (ABPC) in odor and ammonia reduction in poultry droppings. A. M. Raji*, R. A. Salako, A. O. Owosibo, and J. A. A. Sansi, *Federal College of Animal Health and Production Technology*, *Ibadan, Nigeria*.

Poultry odor and emission of ammonia is a major problem in the industry in Nigeria. As a result of this many poultry farms are being forced to stop operation due to urbanization of their locations.

The investigation was conducted to evaluate the efficacy of Advance Bio Pro Concentrate in controlling poultry odor. The experiment consists of treatment and a control sample in triplicate. Poultry droppings already generating odor were collected from the poultry farm of the College. Equal amount of poultry manure was evenly spread out into different transparent rectangular basins, improvising the dip vat under battery cage system of production.

The solution of Advance Bio-Pro Concentrate (ABPC) was prepared with dilution rate of its one part to nine (9) parts of non-chlorinated water. Hence, the diluted mixture of the ABPC was applied by spraying on the surface area of the manure in the basin via a thoroughly cleaned small flitting cylinder. The other basins with the control were not treated.

Visual and smell evaluation was conducted on the treated and the untreated samples for odor reduction at 30 minutes, 12, 24, 48 and 72hrs respectively. Finally, samples of the treated and untreated were analyzed for ammonia phosphates and chemical oxygen demand content (COD).

Initial observation (visuals and smell panel evaluation) indicated a significant reduction in odor reduction from the treated than the untreated within 30 minutes of application. After about 3hours of application, there was sharp reduction in odor formation and further laboratory analysis revealed a mean value of 52.8% reduction in ammonia and 47.6% reduction in oxygen content of the treated samples compared to the untreated samples measuring up to 93.8% and 96.9% for ammonia and oxygen respectively. Another significant observation was gradual drying of the droppings and drastic reduction in maggots production.

These encouraging results indicate the relevance of ABPC in ensuring biosecurity, odor and ammonia control; and waste management in the livestock industry

Key Words: Poultry, Odor, ABPC, Ammonia, COD

T118 Initial laboratory evaluation of SEPTROL SA 102 in digestion of human and poultry waste (Sewage). A. M. Raji*, R. A. Salako, A. O. Owosibo, and J. A. A. Sansi, *Federal College of Animal Health and Production Technology*, *Ibadan, Nigeria*.

Sewage systems in Nigeria are not well developed for the ease of managing effectively human waste and other forms of wastes. Sewage lines are prone to blockage due to non-availability of digesting agent to degrade, digest and reduce odor formation from sewage collection systems.

Preliminary laboratory investigations were conducted to assess the effectiveness and efficiency of Septrol SA 102, in the degradation and odor/ smell reduction of sewage samples collected from pit latrine and dropping from a deep litter poultry system. Two treatment samples were set up in duplicates containing the same amount of waste samples, to one treatment; 0.22g of the septrol was administered according to the directives of the manufacturer. The treated and untreated samples were subjected to the same environmental conditions in the laboratory, and were left for 72hours for the initial inoculations to take place. After the expiration of the ripening period, the following observations were measured; rate of decomposition, odor reduction, intensity of color and volume reduction of the experimental samples. The results from the treated samples clearly showed that inclusion of Septrol reduced the volume, degraded the waste to watery substance, to almost clear solution. Also the odor was significantly reduced compared to the untreated wastes that continue to degenerate and producing maggots. The color of the waste changed from the initial dark brown to almost clear solution. From this initial evaluation, it was observed that Septrol is very effective in managing human and animal waste (sewage) in terms of digestion and odor control, most especially in pit latrine and soak away pits. With the instruction of monthly applications, Septrol is therefore recommended for sewage digestion and odor reduction.

Key Words: Septrol, Sewage, Odor control, Digestion

T119 Evaluation of poultry litter treatment (PLT) at three application rates for broiler chickens. J. P. Blake*, J. B. Hess, K. S. Macklin, and C. A. Wilson, *Auburn University*, *Auburn, AL*.

A total of 1120 commercial broiler chicks (Cobb X Ross) were randomized with 70 birds assigned to each of 16 environmental chambers (2.44 X 2.44 X 2.44 m). Birds were fed a corn-soybean meal starter (1.5 lbs/bird; 22% CP, 3087 kcal/kg), grower (3.0 lbs/bird; 20% CP, 3131 kcal/kg), finisher (4.0 lbs/bird; 17.5% CP, 3197 kcal/kg) and withdrawal (c.a. 3.0 lbs/bird; 16.5% CP, 3219 kcal/kg). Treatments comprised a control (CON) with no litter treatment and PLT at a commercial application rate equivalent to 50, 100, or 150 lbs/1,000 ft2 of floor space with each treatment assigned to four chambers. New pine shavings (54.42 kg) were placed in each pen. Feed and water were provided ad libitum under 24 hrs continuous light. Birds and feed were weighed at 21, 42 and 49 d to determine growth and feed performance. Litter and air quality samples were obtained for analysis initially and on day 7, 14, 21, 28, 35, 42 and 49 of the experiment. Ammonia measurements were conducted using a closed container of specified dimension inverted over the litter bed and determined using a Drager CMS Analyzer equipped with a remote air sampling pump.

The 49-d bodyweight for the 150lb PLT treatment group was greatest as compared to other treatments. Litter pH was significantly lower (P<0.05) for PLT treated pens as compared to CON (6.35 vs. 2.35). However by day 49 there were no differences in pH due to treatment. Results indicated that by day 35 detectable levels of ammonia could be measured and significantly lower (P<0.05) ammonia levels were encountered on days 35 (c.a. 50% lower) and 42 (c.a. 46% lower) for the PLT treatments, but any influence imposed by PLT disappeared by day 49 (P>0.05). Results from pH and ammonia measurements indicate that PLT remained effective on clean shavings through day 42. Litter sample analysis did not indicate an increase in the amount of nitrogen retained due to treatment. Litter moisture increased from a low of 8.9% initially to 24.4% by day 49 with no differences between treatments.

Key Words: Poultry litter treatment, PLT, Ammonia, Broiler

T120 Evaluation of aluminum sulfate (Alum) at three application rates for broiler chickens. J. P. Blake*, J. B. Hess, K. S. Macklin, and C. A. Wilson, *Auburn University*, *Auburn, AL*.

A total of 1120 commercial broiler chicks (Cobb X Ross) were randomized with 70 birds assigned to each of 16 environmental chambers (2.44 X 2.44 X 2.44 m). Birds were fed a corn-soybean meal starter (1.5 lbs/bird; 22% CP, 3087 kcal/kg), grower (3.0 lbs/bird; 20% CP, 3131 kcal/kg), finisher (4.0 lbs/bird; 17.5% CP, 3197 kcal/kg) and withdrawal (c.a. 3.0 lbs/bird; 16.5% CP, 3219 kcal/kg). Treatment comprised a control (CON) with no litter treatment and ALUM at a commercial application rate equivalent to 50, 100, or 150 lbs/1,000 ft2 of floor space with each treatment assigned to four chambers. New pine shavings (54.42 kg) were placed in each pen. Feed and water were provided ad libitum under 24 hrs continuous light. Birds and feed were weighed at 21, 42 and 49 d to determine growth and feed performance. Litter and air quality samples were obtained for analysis initially and on day 7, 14, 21, 28, 35, 42 and 49 of the experiment. Ammonia measurements were conducted using a closed container of specified dimension inverted over the litter bed and determined using a Drager CMS Analyzer equipped with a remote air sampling pump.

No differences (P>0.05) in growth performance were observed during the experimental period. Litter pH was variable among treatments where the highest level of ALUM maintained a significantly lower (P<0.05) pH through day 42 (9.23 vs. 9.68 for CON), while other levels of ALUM were intermediate or similar to CON. By day 49 there were no differences in pH due to treatment. By day 28 detectable levels of ammonia could be measured and significantly lower (P<0.05) ammonia levels were encountered on day 28 (c.a. 35% lower) and 35 (c.a. 59% lower for 100 and 150 lb application) for the ALUM treatments, but any effect due to ALUM treatment dissipated by day 42 (P>0.05). Results from pH and ammonia measurements indicate that ALUM retained its effectiveness on clean shavings through day 35. Litter sample analysis did not indicate an increase in the amount of nitrogen retained due to treatment. Litter moisture increased from a low of 8.9% to 32.4% by day 49 with no differences between treatments.

Key Words: Aluminum sulfate, Alum, Ammonia, Broiler

T121 Evaluation of ferric sulfate for ammonia control in commercial broiler production. C. W. Ritz*[1], L. A. Harper[1], B. D. Fairchild[1], M. Czarick, III[1], and J. Pavlicek[2], [1]*The University of Georgia*, *Athens*, [2]*Kemiron, Inc.*

In-house air quality is a major concern in poultry production. Growers spend much of their time and investment in maintaining good air quality to maximize poultry growth and performance. Previous work has correlated negative bird performance with poor indoor air quality due to ammonia (NH3). Ventilation has been the key means of removing NH3 from poultry houses but the use of litter treatment products that lower pH are also commonly applied. Acid-based litter treatments, though effective for short-term NH3 reduction, may not be viable for long-term ammonia control due to the amount of product required to chemically bind NH3, problems of application when birds are present, and the corrosiveness of the material. New products are needed that can address these issues. The purpose of this study was to evaluate the effectiveness of a new litter amendment containing ferric sulfate compared to an alum-based litter amendment. Since alum is commonly used within the broiler industry and at the request of the participating poultry company, in this study alum was used as the Control and the ferric sulfate product as the Treatment. Both Treatment and Control were applied at the same time and at the same rate of 100 lbs per 1000 ft2. Litter moisture, pH, mineral content, and soluble salts were recorded throughout the study. Ammonia was measured using time weighted detection tubes and gas-washing bottles. The ferric sulfate amendment was, on average, superior to the control in reducing NH3 concentrations during the first 15 days after bird placement with mean NH3 concentrations for the ferric sulfate and alum at 13-19 ppm and 21-26 ppm, respectively. No significant differences were noted in mortality, body weight or feed efficiency. The ferric sulfate product is applicator-friendly with noticeably reduced dust generation upon product application and improved retention of nitrogen in the litter.

Key Words: Ferric sulfate, Ammonia, Broiler, Alum

T122 Reduced ammonia emission diets: Implementation costs and production effects. E. C. Hale III*, *EcoCal Products, LLC*, *Brownstown, IN*.

The effect of a manure ammonia emission reducing diet on egg production and costs at a commercial egg production facility was determined.

A total of 6 hen houses comprised the trial group. Each house had an initial population of 125,000 hens, for a total population of 750,000 hens. The houses were separated into 3 pairs, matching hen age and production status as closely as possible within each pair of houses; however, exact age/production matches were not achieved.

Each house was fed an industry standard diet appropriate to the age and production status of the hens. Production factors, feed costs, and production costs were monitored for 9 weeks prior to introducing the test diet. This data was used to determine the innate differences in feed cost/ton, total egg production, mortality, feed consumption, egg grade, and per-dozen production costs between paired houses. The averaged difference for each parameter was used to correct observed data skewing caused by differences in hen age and production status between paired houses.

Once background performance data was collected, a test diet containing 1.0% clinoptilolite zeolite and 2.5% gypsum by weight was introduced to one house selected from each pair. Production factors and costs were monitored for a total of 14 weeks after introduction of the test diet.

Data from each pair of houses was handled separately from each other pair of houses for the purposes of determining production differences caused by the test diet and its effect on production costs. Once the average differences were determined for each of the 3 pairs, the average differences in production and costs across the 3 pairs were determined.

For the entire population in the study, averaged comparative data indicates that the test diet achieved a 5.9% improvement in total egg production, a 34.6% reduction in mortality, an increase of 3.0% in feed cost/ton, an increase of 3.5% in feed consumed/week, a reduction of 24.7% in undergrade eggs, and an increase of 5.3% in Grade A large + eggs. The comparative difference in the cost to produce one dozen eggs was -3.3%.

Key Words: Dietary manipulation, Production effects, Implementation costs, Ammonia emissions, Hen performance

T123 Efficacy of Elector® PSP (spinosad) for the control of the lesser mealworm (*Alphitobius diaperinus* Panzer) in heavy broilers. S. M. Stringham*[1], D. W. Watson[1], S. Denning[1], K. A. Baker[2], and G. Balme[1], [1]*North Carolina State University*, *Raleigh*, [2]*Elanco Animal Health*, *Greenfield, IN*.

The study evaluated the efficacy of Elector® PSP (spinosad) at two rates applied as banded or broadcast sprays against a broadcast application of Tempo® 1% Dust (cyfluthrin) and an untreated control. Production houses at two farms were randomly assigned as treatments and sampled through two nine-week flock cycles. All treatments were applied within a week of bird removal, immediately after cake-out and routine cleaning. A 0.08% spinosad spray was applied as a banded treatment under feeders, drinkers and along walls. Spinosad treatments (0.16%) were banded as described or applied as a broadcast treatment over the entire floor. Cyfluthrin dust treatments consisted of a single broadcast application at label rates using a power duster. Fifty gallons of water was applied as broadcast spray to control houses. Experimental houses were sampled using modified tube traps placed at twenty locations distributed between wall, feeder and center floor locations within the front three quarters of the houses. Traps were left in place for one week during each sampling period. Pre-treatment samples were taken one week prior to removal of the preceding flock. Subsequent samples were taken at weekly intervals for five weeks following treatment, and again at 7 weeks after treatment. Results demonstrated that, for the most part, spinosad sprays effectively suppressed larval numbers, often by a significant margin over cyfluthrin in comparisons with control houses. Cyfluthrin was more effective against beetle adults at the outset of the trial but was no more effective than spinosad beyond three weeks post treatment.

The study demonstrates that spinosyns are an effective class of insecticides for lesser mealworm control in broiler and other poultry production. It is a welcome addition to the limited array of insecticides currently available. As such, spinosad adds greater flexibility to the insecticide rotations now necessary to manage resistance in lesser mealworms.

Key Words: Spinosad, *Alphitobius diaperinus*, Lesser mealworm, Resistance management, Broilers

T124 Management strategies for utilizing hardwood sawdust as a poultry bedding. G. Malone*[1], S. Collier[1], and D. Rider[2], [1]*University of Delaware*, *Georgetown*, [2]*Department of Natural Resources*, *Annapolis, MD*.

Many concentrated poultry-producing areas of the USA including the Delmarva Peninsula have shortages of quality pine-base bedding materials. Yet, there are often ample supplies of cost-effective hardwood sawdust (HW) that could supplement this deficit. However, the poultry industry has been reluctant to use HW due to periodic mold-induced respiratory health concerns. A demonstration was implemented to evaluate management strategies for utilizing HW as poultry bedding. On a commercial farm growing roaster chickens; loblolly pine (LP), yellow poplar (YP) and white oak sawdust (WO) were each placed in 2 houses. For each bedding type, 1 house received fresh-cut sawdust (SD) directly from sawmills or SD that had been held in storage for 3 months. One half of each house also received a peracetic acid-base mold inhibitor prior to chick placement. The average moisture content of SD for all species at placement in Flock 1 was 31%. Moisture content of SD obtained directly from sawmills was higher (40%) compared to SD held in storage for 3 months (23%). While in storage the temperature of the SD averaged 137 F. Storage and the use of the mold inhibitor had little influence on bedding mold populations. However, there was a two-log reduction in mold populations in Flock 2 compared to Flock 1, and a one-log reduction in LP compared to the HW species. Two-week mortalities were less in Flock 2 for all bedding types. Based on the weight and content of the gizzards there were indications chick prefer consuming the WO. In Flock 1 the incidence of foot pad dermatitis was less with fresh compared to stored bedding and less with YP compared to the other bedding types for both flocks. Based on the physical, chemical and biological observations in this field demonstration, the data is suggestive that YP may be a viable alternative to LP in regions having a bedding shortage. Under conditions of this demonstration, using a mold inhibitor or placing bedding materials in storage had no distinct advantage.

Key Words: Hardwood bedding, Litter, Poultry

T125 The impact of litter type, depth and management on broiler foot pad lesions: Welfare and economic considerations. A. Atencio* and K. Opengart, *Keystone Foods LLC*, *Huntsville, AL*.

Each of sixteen houses on a commercial broiler farm was populated with 22,500 one-day-old Ross x Hubbard Ultra-Yield chicks. The farm was divided into 4, four house units with each house within a replicate having a different litter treatment: 1) one load of peanut hulls, 2) two loads of peanut hulls, 3) one load of pine shavings, or 3) one-half load of pine shavings on top of peanut hulls built-up litter. Birds were randomly placed and were grown using identical management and feed formulation. Foot pad lesions were scored using a scale of 0-2 (0 = no lesion, 1 = mild lesion, 2 = severe lesion) at 43 and 50 days of

age by examining the left and right foot pads of 100 birds per house at each age. At processing, foot pads from 66,080 fifty-six day old birds (19% of each house) were scored using a + or - scale to indicate the presence or absence of lesions, respectively. A highly significant treatment effect was observed. Chicks raised on pine shavings had a lower incidence and less severe paw lesions than chicks raised on peanut hulls. Lesion incidence scored in the house was 12.9^{a} ; 8.4^{a} ; 4.9^{b} and 0.9^{c} and at the processing plant was 9.7^{a}, 10.1^{a}, 1.96^{b} and 1.22^{b} % for the birds raised on one load of peanut hulls, two loads of peanut hulls, one load of pine shavings, or a half load of pine shavings on top of built up litter, respectively (means were compared using the Studen-Newman-Keuls test at 5% probability). It appears that a combination of litter depth and litter source may impact incidence and severity of paw lesions. Improving paw quality has significant welfare and economic implications.

Key Words: Paw lesion, Foot pad podermatitis, Bedding type, Animal welfare

T126 Heat recovery system: Attic ventilation. B. D. Lott*[1] and J. L. Purswell[2], [1]*Mississippi State University*, *Mississippi State*, [2]*USDA*, *Mississippi State, MS*.

Fuel cost has increased to dramatic levels for the poultry farmer. In an attempt to help alleviate some of the burden of increased fuel cost, a system was developed to take advantage of attic heat. With the attic ventilation system, an additional set of ventilation boxes are installed in the middle of the house to pull air out of the attic. On sunny days, the temperature may range from 5° to 20° C higher in the attic than outside temperatures. In summer when the temperatures are hot, the inside temperature of the house can be increased to over 50° C without any fossil fuel usage. A vent box system in the center of the ceiling, independent of the sidewall vent boxes, was installed. Minimum ventilation was used to ventilate the brood area with attic air, rather than outside air.

The system was developed to assist normal brooder operations and reduce the brooder runtime by using the preheated air in the attic. On a sunny day, the system can save as much as 20 percent on fuel cost.

Key Words: Broiler, Attic ventilation, Fuel cost

T127 Why understanding bioethical issues is important. R. D. Reynnells*[1], C. C. Croney[2], and D. J. R. Cherney[3], [1]*US Department of Agriculture, Cooperative State, Research and Extension Service*, *Washington, DC*, [2]*Oregon State University*, *Corvallis*, [3]*Cornell University*, *Ithaca, NY*.

Organizations are changed by decision makers' understanding of issues, organizational requirements and goals, and available options. Agricultural systems are no different. Decision makers may be consumers who make purchasing decisions (thus driving market demands), voters, government officials, animal producers, or company executives. Historically, cheap food demand has been a major change agent for agriculture, as has the desire of farmers to avoid dangerous, repetitive, dirty tasks. Change has often been straight forward in the form of mechanization, consolidation of production (e.g., feed mills serve many farms), vertical integration, or use of chemicals to control diseases or insects. Today, it is increasingly difficult, and yet imperative, to balance ethical considerations with economic and pragmatic factors relative to animal agriculture. This balance is complicated by a perception that some production changes may not be truly market driven but imposed by persons apparently attempting de facto management of producer's resources.

New standards for change are not restricted to questions about how to efficiently raise food animals. Rather, they include concepts of refinement, reduction, and replacement of certain animal management and care practices, and considerations of whether or not we should use animals for food. Should science alone be the basis of our management and regulatory decisions, or should bio-ethical considerations be used in framing housing, genetics, management and disease control decisions? Should a personal or organizational vision of ethical behavior reflecting specific religious or cultural values not held by all members of society be imposed on others or should changes in agriculture come through market demand? What if consumer demand does not reflect an informed or pragmatic decision regarding animal health or welfare? Bioethics increasingly influences decisions by consumers, voters, and regulatory officials. Bioethical concepts should therefore be understood by everyone involved in agriculture in order to properly address the issues presented to society and to inform decisions made in daily practice.

Key Words: Animal welfare, Bioethics, Cheap food, Management, Standards

T128 Share poultry images with others through the animal science image gallery. J. B. Hess* and W. D. Berry, *Auburn University*, *Auburn, AL*.

As the number of faculty dedicated to teaching poultry science in the U.S. continues to decline, the need for poultry-related teaching aids for those with limited access to the poultry industry increases. The Animal Science Image Gallery was created to provide images to middle school, high school and university teachers wishing to include information on animal agriculture in their courses. With the dwindling expertise in poultry at the university level, a reference site of poultry and/or poultry industry images would be a useful teaching tool nationally. The Animal Science Image Gallery was designed to fill this role. Each image on the site comes with a limited description, making it possible for educators to collect images that fit with the portion of the industry that is being discussed. Editors review each image and the corresponding text for accuracy.

Categories exist for most types of agricultural animals, including poultry. Within the poultry site, subcategories include; anatomy and physiology, disease and pathology, housing and equipment, poultry processing and poultry species and breeds. To date, the poultry site does not have a wide range of images available to offer coverage of the many types of poultry operations in the U.S. Please consider uploading images to the site commensurate with your area of expertise. Access

the Animal Science Image Gallery at http://cygnet.richmond.edu/image_gallery to browse or upload images. Contributing to the Image Gallery will ensure that high school and university instructors will have quality poultry science materials to draw from in organizing lectures on poultry science and the poultry industry.

Key Words: Images, Poultry, Pictures

T129 Development of macrolide resistant *Campylobacter* in broilers administered subtherapeutic or therapeutic levels of tylosin. S. R. Ladely*[1], M. A. Harrison[2], P. J. Fedorka-Cray[1], M. E. Berrang[1], M. D. Englen[1], and R. J. Meinersmann[1], [1]*USDA-ARS-Russell Research Center*, *Athens, GA*, [2]*UGA-Food Science and Technololgy*, *Athens, GA*.

The use of antimicrobials in food animal production, particularly those commonly used to treat infections in humans, has become a source of controversy in recent years. However, limited data are available regarding the development of resistance from subtherapeutic or therapeutic administration of antimicrobials in animal production. The objective of this study was to evaluate the effect of FDA approved levels of tylosin administration on susceptibility of *Campylobacter jejuni* and *C. coli* isolated from ceca of treated broilers. In each of three replicate studies, day-of-hatch chicks were exposed to macrolide susceptible *C. jejuni* or *C. coli*. At two weeks of age, tylosin was administered at subtherapeutic (22 ppm, continuously in the diet) or therapeutic levels (529 ppm in drinking water for 5 days). Weekly, 5 broilers per group were sacrificed. Total and resistant *Campylobacter* were enumerated from individual ceca with contents. Macrolide resistance was observed at a higher frequency ($P<0.01$) among *C. coli* isolates 70.8% (17 /24) compared to *C. jejuni* isolates 36.8% (35/95). Resistance was observed at a significantly higher frequency ($P<0.001$) when tylosin was administered at subtherapeutic levels (62.7 %, 47/75), compared to administration of therapeutic levels (11.4 %, 5/44). Subtherapeutic administration resulted in recovery of 83.3 % (15/18) and 56.1 % (32/57) macrolide resistant isolates compared to only 33.3 % (2/6) and 7.9 % (3/38) of the isolates expressing macrolide resistance following administration of therapeutic levels, for *C. coli* and *C. jejuni*, respectively. Further studies are needed to determine the factors involved in the apparent difference in the acquisition of macrolide resistance in *C. coli* compared to *C. jejuni*.

Key Words: Tylosin, Macrolide resistance, *Campylobacter*

T130 Effect of a pelleted experimental chlorate product (ECP) on Salmonella in the ceca of market-age broilers. J. A. Byrd*, J. L. McReynolds, L. F. Kubena, and D. J. Nisbet, *USDA-ARS-Food and Feed Safety Research Unit*, *College Station, TX*.

Previously, our laboratory demonstrated that ECP can be administered in drinking water to reduce *Salmonella, E. coli, and Clostridium* in bovine, porcine and poultry. The objective of this study was to evaluate the effectiveness of a feed grade pelleted ECP and to determine if nitrate pre-adaptation will increase the bactericidal activity of ECP to control *Salmonella* Typhimurium(ST) in market-age broilers. In three trials, at 6 wk-of-age, one hundred and forty broilers were randomly assigned to seven groups of twenty birds and placed in floor pens containing pine litter. Two days prior to slaughter, broilers in group 1 were fed a control finisher diet , groups 2 and 3 were fed either a 1.0% ECP-carrier or salt control, and groups 4 and 5 were provide either 1% or 5% ECP. Groups six and seven were fed a pelleted sodium nitrate diet 4 d prior to termination and then changed to either a 1% or 5% pelleted ECP diet two days prior to termination of the experiment. Prior to placement, each bird was orally challenged with 10^9 ST. Cecal contents were aseptically collected and spread on XLT4 plates to enumerate ST, respectively. Litter was collected from each group to determine moisture content. In the groups fed the salt control diet and 5.0% ECP diets, litter moisture was significantly increased when compared to all other treatments. Mortality was not significant. Pre-nitrate adaptation-5% ECP (0.92 $\log_{10}$ cfu ST) significantly reduced the number of ST recovered from the ceca when compared to the control fed broilers (1.87 $\log_{10}$ cfu ST). These results indicate that pelleted ECP feed prior to slaughter can effectively reduce ST in broilers, and may potentially reduce the risk of contaminating poultry products.

Key Words: Broilers, Experimental chlorate product, *Salmonella* typhimurium, Sodium nitrate

T131 Temperature and oxygen conditions during the plateau stage of incubation affect long bone development in broilers and turkeys. E. O. Oviedo-Rondón*, J. Small, M. J. Wineland, V. L. Christensen, D. T. Ort, K. M. Mann, and S. L. Funderburk, *North Carolina State University*, *Raleigh*.

Previous research suggested that several organs and bone development at hatch could be altered by high temperatures (T) during the plateau stage of incubation. Trials were designed to evaluate the effects of oxygen (O_2) concentrations and the interactions between O_2 and T on bone development in both Ch and turkeys (TU). Two strains of CH with low (LG) and high (HG) eggshell conductance, and one TU strain of LG were used. The first 2 trials O_2 concentrations (17, 19, 21 or 23%) were evaluated. The CH trial was analyzed as a 2x2 factorial design with O_2 concentrations and genetic strain as main effects. The TU trials data was analyzed as a completely randomized design. In the subsequent 2 trials, T (36 and 39 °C) and O_2 concentrations (17 and 23%) were evaluated in a 2x2 factorial design. At day of hatch, 15 CH or poults per strain were selected, both legs were dissected, parts weighed and relative asymmetry (RA) of each leg section calculated. The LG CH strain had heavier ($P<0.01$) body, legs, muscles and bone weights in both trials. CH at the lowest O_2 concentrations had ($P<0.05$) lighter and shorter tibias, lighter shanks, and increased RA of femur length compared to CH in the 23% O_2. Poult body and part weights were not affected ($P>0.05$) by O_2 concentrations, but poults at 23% O_2 had larger shanks and heavier tibias than TU at 17% O_2. High T depressed BW of LG CH, but no significant effect of treatments was observed on BW of HG CH. Nevertheless, in the HG CH, high T caused lighter ($P<0.01$) thighs and shanks; both high T and low O_2 independently caused ($P<0.001$) shorter shanks and lighter drums. Low O_2 reduced femur and tibia weight, length, and increased RA of drums. In the LG CH, high T decreased ($P<0.001$) shank weight and thickness; low O_2 caused shorter shanks, and both low O_2 and high T together increased ($P<0.05$) RA in shank weight. In trial 4 with TU, high T depressed ($P<0.01$) BW, leg muscle weights, and shank length. Low O_2 reduced ($P<0.05$) tibia and shank %. Incubation conditions affect long bone development in CH and TU and may have an impact in leg health.

Key Words: Broilers, Turkeys, Incubation, Bone development, Leg health

Tuesday, January 23, 2007
Nutrition IV
Room: B315

T132 Meta Analysis of dietary amino acid responses of broiler chickens. W. A. Dozier, III*[1], M. T. Kidd[2], and A. Corzo[2], [1]*USDA-ARS Poultry Research Unit*, *Mississippi State, MS*, [2]*Mississippi State University*, *Mississippi State*.

Defining the optimal balance of critical amino acids for diet formulation is of utmost importance to practicing nutritionists. This study summarized six peer-reviewed manuscripts that evaluated dietary amino acid density regimens that were published during 2003 to 2006 from USDA-ARS or Mississippi State University. Diets providing optimal growth responses during starter, grower, finisher, and withdrawal periods from the six manuscripts were used. Regression analyses were conducted with respect to bird age to generate prediction equations for dietary amino acid percentages, daily amino acid consumption, and daily amino acid consumption per unit of BW gain. Actual analysis of amino acids was used instead of calculated values. Regression equations for dietary Lys percentage, Lys consumption (mg/d), and daily Lys consumption per unit of BW gain (mg/g/d) had R^2 values of 0.93, 0.99, and 0.90, respectively. Predicted dietary Lys percentages were 1.36, 1.26, 1.19, 1.12, 1.06, 1.01, and 0.97 and dietary Lys consumption (mg/d) was 464, 861, 1,195, 1,466, 1,675, 1,821, and 1,904 for 7, 14, 21, 28, 35, 42, and 49 d, respectively. The R^2 values for dietary TSAA percentages, TSAA consumption (mg/d), and daily TSAA consumption per unit of BW gain (mg/g/d) were 0.86, 0.99, and 0.93, respectively. Predicted dietary TSAA percentages were 0.94, 0.90, 0.85, 0.81, 0.77, 0.74, and 0.70 and dietary TSAA consumption (mg/d) was 324, 623, 873, 1,074, 1,228, 1,333, and 1,390 for 7, 14, 21, 28, 35, 42, and 49 d, respectively. Dietary Thr percentage, Thr consumption (mg/d), and daily Thr consumption per unit of BW gain (mg/g/d) had R^2 values for 0.86, 0.99, and 0.92. Predicted dietary Thr percentages were 0.84, 0.81, 0.77, 0.74, 0.71, 0.69, and 0.67 and dietary Thr consumption (mg/d) was 290, 555, 779, 962, 1,104, 1,207, and 1,268 for 7, 14, 21, 28, 35, 42, and 49 d, respectively. These results provide dietary amino acid estimates for formulating diets throughout a 7 wk production period; however, these values are based upon dietary amino acid density research and not on minimum requirements.

Key Words: Amino acid, Broiler, Lysine, Mmethionine, Threonine

T133 Practical dietary L-threonine inclusion and resultant impact on broiler growth, yield, and nitrogen excretion. M. T. Kidd*[1], A. Corzo[1], W. A. Dozier, III[2], C. D. Coufal[1], B. J. Kerr[3], and D. Hoehler[4], [1]*Mississippi State University*, *Mississippi State*, [2]*USDA*, *Mississippi State, MS*, [3]*USDA*, *Ames, IA*, [4]*Degussa Corporation*, *Kennesaw, GA*.

The dietary inclusion of L-Thr has necessitated accurate knowledge of nutrient amino acid needs beyond Thr. Research delineating the former has been forthcoming, but remains sparse. As a result, many commercial nutritionists have included L-Thr using company historical data on CP fluctuations and bird performance. In this experiment, practical inclusions of L-Thr were used which resulted in a 1.3% decrease in CP. Cobb x 500 (fast feathering) broilers were reared in floor pens. At d 25, male broilers were selected, tagged, and placed across 24 pens (6 birds/pen). Three dietary treatments were fed from 25 to 43 d: 19.88% CP with no L-Thr; 19.25% CP with 0.023% L-Thr; and 18.62% CP with 0.045% L-Thr (8 replications/treatment). The highest and lowest CP pelleted treatments were blended to get the middle CP level. In addition to obtaining live performance and processing data on all birds, plastic was lined in the pens to obtain a 24 h collection of feces at d 32. All pens were positioned whereby the adjacent pen contained no birds to minimize fecal contamination. Protein efficiency ratio did not differ among treatments. Other live performance parameters did not differ ($P > 0.05$). Percentage abdominal fat increased ($P = 0.07$) as L-Thr increased, but other carcass measurements did not differ. Nitrogen excretion was highest ($P = 0.13$) in birds fed no L-Thr. Results indicate that Cobb male broiler live performance and processing traits can be maintained in reduced CP-L-Thr containing diets, and nitrogen excretion benefits may be realized.

Key Words: Amino acid, Threonine, Broiler, Protein efficiency ratio, Nitrogen excretion

T134 Impact of feeding reduced protein diets on performance, breast yields and nitrogen emissions in broiler chickens. R. Angel*[1], W. Powers[2], S. Zamzow[2], T. Applegate[3], and D. Hoehler[4], [1]*University of Maryland*, *College Park, MD*, [2]*Iowa State University*, *Ames*, [3]*Purdue University*, *Lafayette, IN*, [4]*Degussa Corporation*, *Kenessaw, GA*.

The impact of feeding reduced protein (RP) and industry (C) corn-soy diets on broiler performance, breast yield and litter nitrogen (N) content was determined. Ross 308 male broilers were allocated to 8 chambers and grown from hatch to 42 d. Five sequential Exp were conducted. C treatment (Trt) broilers were fed a 4 phase feeding program: starter (St), grower (Gr), finisher (Fn), and withdrawal (Wd) diets. RP Trt broilers were fed a 6 phase feeding program: prestarter (PrSt), St, Gr1, Gr2, Fn, and Wd diets. Protein concentrations were 22.1, 20.0, 17.2, and 16.6% for the C Trt St, Gr, Fn, and Wd diets, while those for the RP Trt PrSt, St, Gr1, Gr2, Fn, and Wd diets were 22.0, 18.6, 18.1, 17.3, 15.8, and 15.0%. Minimum amino acid (AA) requirements as well amino acid to lysine ratios were maintained for diets in both Trt. Synthetic Lys, Met, Ile, Thr, Arg, Trp, and Val were used to meet AA minimums in RP diets while only Met and Lys were used to meet the same minimums in C diets. Total concentrations of Lys, Met+Cys, Ile, Thr, Trp, Arg, and Val, in the St, Gr1, Gr2, Fn, and Wd RP diets were: 1.22, 0.91, 0.85, 0.82, 0.24, 1.40, 0.90%; 1.14, 0.83, 0.82, 0.68, 0.23, 1.25, 0.90%; 1.06, 0.80, 0.75, 0.74, 0.22, 0.83%; 1.01, 0.75, 0.71, 0.68, 0.20, 0.80%; and 0.96, 0.73, 0.70, 0.68, 0.19, 0.76%, respectively. Performance was determined at the end of each phase and litter was analyzed for DM, N and minerals. Ammonia (NH3) emissions were calculated by sampling incoming air followed by sequential sampling

of each chamber. Broilers on the C Trt weighed more ($P < 0.05$) at 42 d over the five F (2.74 kg) than those fed the RP Trt (2.66 kg) but feed/gain ratio was similar (1.88 vs. 190 for C and RP). Twenty broilers per chamber were sampled for yield determination in F 3 and 4. Dress percent, breast weight and breast yields were not affected by Trt. Based on analyzed diet, litter and air concentrations over the 5 F, N consumed was 9.2% less, litter N 20.6% less, and mean NH3 emissions were 16% lower in RP vs. C chambers. The study demonstrates that N emissions can be reduced substantially by feeding low-protein diets in broilers.

Key Words: Broiler, Protein, Nitrogen, Emissions

T135 Carcass defects with broilers fed requirement EAA levels from 6 to 8 weeks of age while CP and ME varied at practical extremes. E. T. Moran* and J. Galobart, *Auburn University*, *Auburn, AL*.

Formulating feed using commercial EAA reduces associated CP, and performance suffers when fully implemented. Experimentation examined incidence of carcass defects when CP was maximally decreased with the final feed, and if reducing ME to increase consumption of CP would provide relief. Ross X Ross 308 broilers were reared sexes-separate in floor pens from 0 to 6 weeks of age on common feeds. During the subsequent 6 to 8 weeks (25 C and 80% RH), feeds having CP at either 18.0 or 16.5% while ME was either 3250 or 3090 kcal / kg were given to 4 replicate pens of 25 chicks. All feeds employed corn, soybean meal, poultry fat, and purified essential amino acids as the central ingredients. AA analyses confirmed NRC(1994) requirement levels. Reducing CP adversely affected both live weight gain and F/G of both sexes between 6 and 8 weeks of age while reduction in ME independently increased F/G without altering growth. After on-line processing, static slush-ice carcasses were evaluated for the incidence of wings having dislocated joints, bruising, broken bones, and brachial veins having prominent blood; drumsticks with broken bones and bruising; breast bruising and broken clavicles; and back-thigh area having bruising, skin tear and scratching, ANOVA evaluated transformed percentages from each pen. Wing bruising was the defect having the greatest incidence (19.0%) and breast bruising the least (0.4%). No significant effects were detected that could be attributed to level of CP, ME or their interaction ($P>.05$). Males exhibited a greater vascular disruption of blood in the wing veins, broken drumsticks and bruising of the back than females while the converse occurred for drumstick bruising and skin tearing of back-thigh ($P<.05$). Absence of carcass defects associated with wide levels of feed CP and ME suggest infers that a minimal adverse effect on welfare audit and consumer quality exists in a practical context.

Key Words: Carcass quality, Feed formulation, Metabolizable energy, Protein nutrition, Welfare audit

T136 Dietary amino acid responses of broiler chickens from 36 to 47 d on subsequent 60 d performance. W. A. Dozier, III*[1], M. T. Kidd[2], A. Corzo[2], J. Anderson[3], and S. L. Branton[1], [1]*USDA-ARS Poultry Research Unit*, *Mississippi State, MS*, [2]*Mississippi State University*, *Mississippi State*, [3]*Mississippi State University*, *Mississippi State*.

Dietary amino acid responses of broilers from 5 to 9 wk of age have not been well defined. This study examined growth responses and meat yield of broilers provided diets varying in amino acid density from 36 to 47 d of age on 60 d performance. Sixteen hundred and sixty-four Ross × Ross 708 chicks were randomly distributed into 32 floor pens (26 males and 26 females; 0.08 m^2/bird) at one-d of age. All birds were fed common starter (0 to 17 d) and grower (18 to 35 d) diets. Broilers were provided diets characterized as being high (H), moderate (M), or low (L) in amino acid density from 36 to 47 and 48 to 60 d of age. The diets were formulated to contain: H (19.0% CP, 0.75% digestible (d) TSAA, and 0.92% dLys), M (18.0% CP, 0.73% dTSAA, and 0.85% dLys) , and L (16.8% CP, 0.70% dTSAA, and 0.78% dLys) amino acid density from 36 to 47 d, and H (17.6% CP, 0.70% dTSAA, and 0.88% dLys) and L (16.1% CP, 0.63% dTSAA, and 0.75% dLys) amino acid density from 48 to 60 d. Dietary treatments were HH, HL, ML, and LL from 36 to 60 d of age.

Broilers provided the HH regimen had lower ($P\leq0.05$) final feed conversion and less ($P\leq0.05$) abdominal fat percentage than ML and LL fed broilers. Decreasing dietary amino acid density from HH to LL regimen reduced ($P\leq0.05$) total breast meat weight and yield. Dietary treatments did not influence final BW, cumulative feed intake, cumulative mortality, or carcass weight and yield. These results indicate that reducing dietary amino acid density from H to L during 36 to 47 d negatively impacted 60 d feed conversion and breast meat yield under these experimental conditions.

Key Words: Amino acid, Broiler, Lysine, Methionine, Theonine

T137 Dietary amino acid responses of broiler chickens from 48 to 60 d on growth and carcass traits. W. A. Dozier, III*[1], M. T. Kidd[2], A. Corzo[1], J. Anderson[3], and S. L. Branton[1], [1]*USDA-ARS Poultry Research Unit*, *Mississippi State, MS*, [2]*Mississippi State University*, *Mississippi State*, [3]*Mississippi State University*, *Mississippi State*.

Dietary amino acid responses of broiler chickens from 7 to 9 wk of age are sparse. This study examined growth responses and meat yield of broilers provided diets varying in amino acid density from 48 to 60 d of age. Sixteen hundred Ross × Ross 708 chicks were randomly distributed into 32 floor pens (25 males and 25 females; 0.08 m^2/bird) at one-d of age. All birds were fed common starter and grower diets until 35 d of age. Broilers were provided diets characterized as being high (H), moderate (M), low (L), or sub-optimum (S) in amino acid density from 48 to 60 d of age. The diets were formulated to contain: H (17.9% CP, 0.70% digestible (d) TSAA, and 0.87% dLys), M (16.9% CP, 0.65% dTSAA, and 0.81% dLys), L (15.8% CP, 0.60% dTSAA, and 0.75% dLys), or S (14.8% CP, 0.55% dTSAA, and 0.69% dLys).

Broilers provided the H regimen had improved ($P\leq0.05$) cumulative feed conversion over the other dietary treatments. Feeding the S diet to broilers decreased ($P\leq0.05$) carcass yield compared with the other dietary treatment, whereas H fed broilers had lower ($P\leq0.05$) abdominal fat percentage than the M, L, and S fed broilers. Providing the S diet to broilers limited ($P\leq0.05$) total breast weight (Pectoralis major and minor muscles) compared with the H dietary treatment, but broilers fed the M and S diets had lower ($P\leq0.05$) total breast meat yield than broilers given the H diet. The least significance difference

critical value for breast meat yield was 0.48% and the breast meat yield difference between H and L broilers was 0.46% (24.00 vs. 23.54%), thus inferring a breast meat yield difference was approaching significance between the H and L fed broilers. These data indicate that feeding the H diet from 48 to 60 d is advantageous to optimize cumulative feed conversion and maintain optimal total breast meat yield.

Key Words: Amino acid, Broiler, Lysine, Methionine, Threonine

T138 Valine marginality and needs of growing broilers. A. Corzo*[1], M. T. Kidd[1], W. A. Dozier, III[2], and S. L. Vieira[3], [1]*Mississippi State University*, *Mississippi State*, [2]*USDA-ARS*, *MS*, [3]*Universidade Federal do Rio Grande do Sul*, *Porto Alegre, Brazil*.

Valine is likely the fourth limiting amino acid in some diets than contain feedstuffs only from vegetable origin. Three experiments (Exp) from 21 to 42 d of age were conducted to not only corroborate the previous statement, but to validate a Val deficiency and subsequently quantify an adequate ratio to lysine. A high yield broiler male (Ross×Ross 708) was used in all Exp. In Exp 1, L-Thr was included into a corn-soybean meal diet where no other essential amino acid minimums were imposed other than those for Lys, TSAA and Thr. Individually, L-Val, L-Ile, L-Arg and Gly were supplemented by 0.10% to that diet. Based on results obtained for BW gain, feed conversion and abdominal fat weight and percentage, birds were most responsive when L-Val was supplemented to the diet when compared to other supplemented amino acids. Subsequently, Exp 2 compared a corn-peanut meal diet against a corn-soybean meal diet. The corn-peanut meal based diet was formulated to be deficient in Val, which indeed occurred as observed by poor performance BW gain and feed conversion; subsequent supplementation with L-Val validated the Val deficiency. Further, a comparison between the corn-peanut meal L-Val supplemented diet and the corn-soybean meal diet of similar nutritional composition validated the use of the corn-peanut meal based diet in its ability to support adequate growth of broilers. Finally, Exp 3 used the same corn-peanut meal based diet to create a dose-response, where Val would be deficient (0.59% digestible) and gradual increments of dietary Val were accomplished by supplementing L-Val to the diet. Quadratic effects were observed for BW gain, breast meat weight and its yield, where a dietary Val to Lys ratio would be adequate between 74 and 78.

Key Words: Breast meat, Broiler, Lysine, Valine

T139 Selenium sources affect protein concentration, thioredoxin reductase activity and selected production parameters in reovirus infected broilers. S. Burgos*[1], F. W. Edens[1], J. Read-Snyder[1], A. Cantor[2], and S. A. Burgos[3], [1]*North Carolina State University*, *Raleigh*, [2]*University of Kentucky*, *Lexington*, [3]*University of Guelph*, *Guelph, ON, Canada*.

Avian reoviruses (ARV) are members of the *Orthoreovirus* genus within the *Reoviridae* family. Successful ARV infection ultimately result in decreased weight gains coupled with increased mortality. Selenium (Se) is involved with Thioredoxin Reductase (TRX), an enzyme that quenches free radicals that can damage proteins, lipids and nucleic acids. The aim of this study was to determine the effects that Se-containing diets fed to ARV-infected broilers had on protein concentrations, TRX activity, body weights and mortality. Eggs were obtained from Cobb breeders that had been maintained on isocaloric Torula yeast diets containing either no supplemental Se, sodium selenite at 0.3 ppm, or organic Se (SelPlex, Alltech, Inc., Nicholasville, KY) at 0.3 ppm. Chicks hatched from those eggs were placed on Torula yeast broiler diets containing no supplemental Se, 0.3 ppm sodium selenite, or 0.3 ppm organic Se similar to their respective parents' diets. On the day of hatch, 60 chicks per dietary Se treatment were placed into either control or ARV-infected groups in heated-growing batteries in separate isolation rooms. Chicks in the ARV-infected groups were given each an oral gavage of 0.2 mcL of ARV-CU98 ($10^{4.2}$ pfu/chick), and control chicks were given the medium only. At 14 and 21 days of age, the chicks were bled, weighed, killed by CO^2 asphyxiation, and tissues collected for analyses. Data from this 2 X 3 factorially arranged completely randomized experimental design were analyzed using the GLM procedure of SAS. ARV-infected birds had significantly lower average body weights (ABW) at 14 and 21 days ($P<0.0001$), three times higher mortality rates, and decreased tissue protein concentration ($p<0.001$) than controls. Se treatments did not affect ABW and mortality, but did significantly improve plasma protein concentration ($p<0.05$) and TRX activity in both, healthy and virus-challenged bird. Our findings suggest that ARV infection depresses growth, increases mortality and reduces protein concentration on various tissues, whereas Se is beneficial against ARV infection in broilers through an improved antioxidant status.

Key Words: Reovirus, Selenium, Broiler

T140 Effects of reducing dietary protein on performance of White Leghorn layers during late egg production (55 to 67 wks of age). H. M. Yakout*[1], D. Hoehler[2], M. Elliot[3], and C. Novak[1], [1]*Virginia Tech*, *Blacksburg*, [2]*Degussa*, *Kennesaw, GA*, [3]*Wenger's Feed Mill*, *Rheems, PA*.

The use of low protein diets can have potential benefits on reducing N emissions and cost savings by reducing high cost protein sources. An experiment was conducted utilizing 384 Hy-Line W-36 hens which were randomly assigned to one of 4 dietary treatment groups (Trt). Corn-soybean based diets supplemented with commercially available amino acids were used as follows: [1] 17.5% CP + Met ($131.25/ton), [2] 16.5% CP + Met, Lys and Thr ($128.67/ton), [3] 15.5% CP + Met, Lys and Thr ($127.56/ ton), and [4] 14.5% CP + Met, Lys, Thr and Trp ($129.14/ton) were fed from 55 to 67 wks of age. Cage was the experimental unit (4 h/cage; 0.54 in^2/h), and each Trt had 24 reps. Overall, hens had similar feed consumption (FI) in diet 1, 2, 3, & 4 of 99.0, 99.5, 99.1 and 97.9 g/h/d, respectively. Egg production (EP) ranged from 71.4 to 67.1% across all Trt with the highest producers fed diet 2 and the lowest for diet 4. Egg weights (EW) followed a similar performance, as they non significantly decreased from 63.7 g to 63.0 g with protein reduction from 17.5 to 14.5%, respectively. Egg mass (EM) was also not affected by Trt and varied from 44.08 to 44.80 g. Reducing dietary protein reduced ($P \leq 0.003$) dry albumen percent, while numerically increased dry shell percent. Albumen solids were reduced ($P \leq 0.005$) with decreasing dietary protein. Wet albumen ranged from 57.0 to 55.5% ($P \leq 0.03$) for all Trt with the highest at diet 3 and the lowest at diet 4. FI, specific gravity, dry yolk and shell and yolk solids were not significantly affected by Trt. Treatments 1, 2 and 3 were statistically similar when evaluating production performance

and egg components as compared to diet 4. Based on the information gathered from this trial, feeding the 15.5% CP diet with supplemental Met, Lys and Thr matched EP and FE of the high protein diet (17.5% CP + Met). Utilizing such a diet in the field has the potential to save the poultry industry as much as $3.68/ton based on the current study. Additional in house or field studies are needed to validate these findings on increased profitability.

Key Words: Dietary protein, Egg production, Egg mass, Late production, Economics

T141 Effects of dietary amino acid level on egg performance of heavy versus light laying hens. R. L. Payne*[1], P. R. T. Bonekamp[2], J. K. W. M. Sparla[2], A. Lemme[1], and P. J. A. Witten[2], [1]*Degussa Corporation*, *Kennesaw, GA*, [2]*Provimi B.V.*, *Rotterdam, The Netherlands*.

According to the literature, the amino acid (AA) needs of light layer breeds are about 10% less than those of heavy breeds. Thus, the objective of this experiment was to determine the level of AAs needed for heavy and light breeds for optimal performance. Lohmann Brown Classic (heavy) and LSL Classic (light) hens (n = 564) were equally allotted to 12 treatments based on body weight and daily egg mass. Each treatment was replicated 4 times with 11 or 12 individually-housed hens, and the trial was conducted from 24 to 35 weeks of age. The treatments were arranged in a 2 x 6 factorial with 2 breeds (light vs. heavy) and 6 AA levels (550, 600, 650, 700, 750, and 800 mg of true fecal digestible Lys per hen per day (TFD Lys/h/d)). The diets were formulated based on body weight and energy requirements for the heavy or light hens with 10 g of growth per month with a calculated feed intake of 110 or 100 g/h/d, respectively. Minimum ratios of AAs relative to TFD Lys were maintained, and they were Met, 49; Met+Cys, 95; Thr, 68; Trp, 19; Ile, 79; and Val, 87. All diets were isocaloric within breed and adequate in all nutrients with the exception of AA. Laying percentage of the heavy and light breed hens increased ($P < 0.05$) up to 650 and 600 mg TFD Lys/h/d, respectively, but laying percentage was not different ($P > 0.05$) overall. Egg weight, egg mass, and feed per egg mass increased ($P < 0.05$) in both breeds as AA increased through 800 mg TFD Lys/h/d. Overall, the heavy breed hens produced heavier eggs with more mass ($P < 0.05$), while the light breed hens had improved feed per egg mass ($P < 0.05$). These data suggest that both breeds respond to at least 800 mg TFD Lys/h/d for daily egg mass production, which is higher than current recommendations. Furthermore, it seems that heavy breeds need about 10% more AAs than the light breeds to maximize laying percentage, while the light breeds need about 10% more AAs to produce similar egg mass as the heavy breeds.

Key Words: Amino acid, Egg mass, Laying hen, Lysine

T142 Mintrex® organic trace minerals and 25-hydroxycholcalciferol HyD® improve biomechanical properties of turkey bones. E. O. Oviedo-Rondón*[1], P. L. Mente[2], P. R. Ferket[1], J. D. Richards[3], J. Small[1], and J. L. Grimes[1], [1]*North Carolina State University*, *Raleigh*, [2]*North Carolina State University*, *Raleigh*, [3]*Novus International, Inc.*, *St. Charles, MO*.

Spiral femoral fractures and tibia fractures can cause up to 5% of the total mortality in turkey toms. Biomechanical properties of bones can be improved by nutrition. The dietary supplementation of organic trace minerals, MINTREX Pse (MIN) and 25-hydroxycholcalciferol (HyD) was evaluated as an alternative to reduce the incidence of bone abnormalities. Day-old Nicholas 85X700 toms were randomly distributed among 48 pens (4 dietary treatments (trt) x 12 replicates) of 15 poults each. A 2x2 factorial (0 and.1% MIN; 0 and 92 mcg/kg HyD) was evaluated. MIN provided 40 ppm Zn, 40 ppm Mn, and 20 ppm Cu as methionine hydroxy analogue complex and .3 ppm Se as Se yeast. Diets were formulated to be equal in nutrient content and fed ad lib as 8 feed phases until 20 wk. Femur and tibia bones were collected at 18 wks of age from 13 toms per treatment. Compression and tension failure stresses were evaluated in tibiotarsus subjected to three-point and four-point bending. Torsional shear stresses were evaluated in femur bones subjected to external rotation in a single cycle to failure, at an angular displacement rate of 10°/s. Torque and angle data were collected during the test at 100 Hz. Data indicated that MIN increased ($P<0.001$) cortical thickness in the tibiotarsus. No significant ($P>0.05$) effect of trt was observed in the cortical thickness of femur. The maximum force, the moment and the stress required for tibia bones to break, increases ($P<0.001$) with MIN supplementation, but especially ($P<0.05$) when both MIN and HyD were added to the diet. The maximum shear stress at failure of femora bones was improved ($P<0.05$) by MIN and HyD supplementation, a similar effect ($P=0.08$) was observed for failure torque. These results indicate that the supplementation of both MIN and HyD improve the biomechanical properties of tibias and femurs in 18 wk-old turkey toms.

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Key Words: Bone, Turkeys, Biomechanical properties, Organic trace minerals, Vitamin D

T143 A real time polymerase chain reaction assay for metallothionein to measure bioavailability of zinc sources for chickens. J. D. Richards*, C. A. Atwell, C. W. Wuelling, and M. E. Wehmeyer, *Novus International, Inc.*, *St. Charles, MO*.

It is common to measure bone or tissue zinc to compare the bioavailability of different zinc sources, or to determine the zinc status of an animal. However, zinc deposition into tissues occurs substantially downstream of intestinal zinc absorption, and only a fraction of the absorbed zinc will be deposited in the assayed tissue. Therefore, tissue or bone zinc may not be the most appropriate assay to measure bioavailability. As an alternative, the availability of zinc can be compared by detecting the expression of certain zinc-responsive genes. The metallothionein (MT) protein binds up to 7 zinc atoms, and its mRNA or protein expression has been reported to reflect zinc status in many species, including chickens. A real time polymerase chain reaction (RT-PCR) assay was developed to measure MT mRNA expression in chickens fed different levels or sources of zinc. Initial experiments demonstrated that MT was inducible by zinc in multiple tissues including small intestine, liver and kidney. In contrast, 18S rRNA was not zinc-inducible. MT mRNA levels therefore are normalized in each sample by 18S rRNA levels, as a loading control. In addition, MT levels can be compared across experiments by comparing to a known reference standard. To test whether the MT assay could distinguish between different zinc sources, broilers were placed on a moderately zinc-deficient milo-soy diet for 20 days, then placed on corn-soy treatment diets consisting of an unsupplemented basal diet, or

the basal supplemented with 70ppm zinc from zinc oxide, a zinc amino acid complex, or MINTREX® Zn. Jejunum scrapings were collected two days later and assayed for MT expression. Zinc oxide and the zinc amino acid complex failed to induce MT expression significantly above the basal. In contrast, MT expression in the birds fed MINTREX Zn was significantly greater than in all other treatments. These data suggest that MINTREX Zn is more bioavailable than zinc oxide or the zinc amino acid complex.

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Key Words: Metallothionein, RT-PCR, Zinc, MINTREX, Bioavailability

T144 The making of heat resistant β-Mannanase (Hemicell®-HR) and its positive impact on broiler growth performance. H. Y. Hsiao*, D. M. Anderson, and L. Liu, *ChemGen Corp.*, *Gaithersburg, MD*.

Feed enzymes, in general, are sensitive to heat and, therefore, their application onto feeds is mostly carried out by spraying in the liquid form post-pelleting. However, the direct application of thermal stable dry enzyme into the mixer still has its attraction. Strains of *Bacillus lentus*, which all produce thermal stable β-Mannanase (Hemicell®-HR) have been obtained by modifying a few selected sites on DNA sequence of the native enzyme and, then, replacing the native gene on the same host cell. Two such mutants were selected. The native and two mutant enzymes have been purified and they were incubated in a water bath at various temperatures for 15 minutes. The native and stable β-mannanase (Hemicell® HR-1 and HR-2) retained its 50% activity at 65°C, 72°C and 82°C, respectively. Two mutants, in their unprotected form, showed a 7°C and 17°C improvement in thermal stability over the native enzyme. All three enzymes were granulated and their thermal stability was tested under various conditioning temperatures (65°C - 90°C) by feed mills at Kansas State University and the University of Georgia. Through the extrapolation, the pelleting temperature causing a loss of 50% activity to the granulated native and two thermal stable β-Mannanase was calculated to be 80°C, 87°C and 107°C, respectively. A 42-day broiler trial was conducted to test Hemicell®-HR1 and the native enzyme for grwoth. The native Hemicell® was sprayed post-pelleting and the granulated Hemicell®-HR-1 was applied into mixer. Both were at about 100MU/ton. All feeds were pelleted between 80-85°C. There was no significant difference in FCR as well as weight gain between these two enzymes. Both enzymes had significant better FCR than the Control ($P<0.05$). The thermal stable β-mannanase added into the mixer showed its full efficacy in promoting broiler growth.

Key Words: β-mannanase, Thermal stable, Mmutant, Broiler, FCR

T145 The effect of B-Mannanase (Hemicell) on the performance of 3 commercial strains of broiler chickens provided with corn-soybean meal diets. M. E. Jackson*[1] and R. W. Gordon[2], [1]*ChemGen Corp*, *Fayetteville, AR*, [2]*Gold Kist Inc*, *Atlanta, GA*.

The enzyme B-mannanase has been shown to improve growth, feed conversion and body weight uniformity in broilers. The mechanism results in an improvement in energy utilization through degradation of highly anti-nutritive B-mannans present in all soybean meals. A 38-day trial was conducted in floor pens with straight run Ross X Cobb, Cobb X Cobb, and Ross X Ross broilers provided with corn-soybean meal based diets with commercial nutrient levels with and without B-mannanase addition at the manufacturers recommended inclusion level (100 MU/ton) for a total of 6 treatments. The study involved 50 birds/pen and 8 replicate pens per treatment. At the conclusion of the study, males and females were weighed separately. The enzyme improved weight gain and feed conversion in all strain and sex combinations at 38 days. Across all strains and sexes, the addition of B-mannanase resulted in a 2.5% improvement in weight gain ($P<.05$) and a 2.6 point improvement in feed conversion ($P<.05$). There were significant strain effects on feed conversion only and there were no significant strain x enzyme interactions. Results of this study suggest that B-mannanase improves live performance in broilers irrespective of sex or strain.

Key Words: B-Mannanase, Broilers, Strain, Sex

T146 Effect of Allzyme® SSF on growth performance of broilers receiving diets containing high amounts of distillers dried grains with solubles. J. L. Pierce*, T. Ao, B. L. Shafer, A. J. Pescatore, A. H. Cantor, and M. J. Ford, *Alltech-University of Kentucky Nutrition Research Alliance*, *Lexington, KY*.

Allzyme® SSF is an enzyme complex produced by solid state fermentation. An experiment was conducted to evaluate the effects of Allzyme® SSF on the growth performance of male broiler chicks when fed diets containing 26% dried distillers grains with solubles (DDGS). A 21-day growth assay was conducted with 144 Cobb broilers allotted to four dietary treatments in a randomized complete block design. The treatments were 1) corn-soy reference diet with 1.24% Lys, 22%CP and 3150 kcal/kg ME; 2) positive control diet containing 25% DDGS with 1.24% Lys, 22%CP and 3150 kcal/kg ME; 3) and 4) containing 26% DDGS with 1.11 % Lys, 21%CP and 2835 kcal/kg ME without and with 200 g/tonne Allzyme® SSF, respectively. Feeding 25% DDGS significantly decreased weight gain (737 vs. 691g, $P<.01$) and gain:feed (0.766 vs. 0.676, $P<0.01$) comparing with corn-soy reference diet. Reducing the dietary energy and crude protein concentration also reduced gain (691 vs. 626 g, $P<0.01$) and gain: feed (0.676 vs. 0.579, $P<0.01$). The addition of Allzyme® SSF tended to increase gain (626 vs. 648 g) and significantly increased gain:feed (0.579 vs. 0.610, $P<0.01$). These results indicate that Allzyme® SSF improves growth and efficiency when high levels of DDGS are used in broiler diets.

Key Words: Broiler chicks, Enzyme, Allzyme®SSF, DDGS, Performance

POSTERS
Monday, January 22, 2007
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P147 Four years of molecular analysis of international samples collected on FTA® paper. H. Moscoso*, G. Brown, and C. L. Hofacre, *University of Georgia*, *Athens*.

The Molecular Diagnostic Laboratory at PDRC performs more than 13 different tests for the detection and characterization of avian pathogens for national and international clients. We have shown that avian viruses and bacteria are rendered non-infectious upon contact with the FTA® cards thus allowing collection and transport of samples from overseas to the U.S. in compliance with federal regulations. PCR and RT-PCR have demonstrated that nucleic acids are preserved in specimens stored on FTA® and that its quality is sufficient to yield amplicons suitable for post-PCR analysis. The number of tests for molecular analysis of poultry samples requested by clients from foreign countries has increased almost 100 fold in the past 4 years; from 8 tests in 2002 to more than 800 tests in 2005. This increase is mainly due to the switch in the procedure of inactivation and transport of potential pathogens from phenol-treated to FTA® -collected specimens. The majority of the international molecular tests requested are from Latin America (88%) which is the consequence of a great deal of training and education of laboratory personnel and clinicians from governments, academia and private industries from that area of the world. Mycoplasma PCR is by far the most requested test from overseas representing 68% followed by RT-PCR of IBDV, IBV, and NDV with an average of 11%, 7%, and 5% respectively in the past 4 years. Post-PCR tests such as RFLP and nucleotide sequencing have allowed studying more closely the epidemiology of these diseases in foreign countries resulting in the differentiation of vaccines from pathogens. Cumulative positive cases was 37% for NDV (vaccine and velogenic strains), 36% for adenovirus (serotype 4, 5 and 10), 29% for IBDV (Lukert and variants A and E), 27% for MS (H vaccine and wild types), 23% for MG (ts 11, F strain and wild types), and 8% for IBV (Massachusetts). Tests request from other areas of the world might increase in the near future as sampling is facilitated and transportation cost is reduced using the FTA® cards.

Key Words: Avian pathogens, FTA®, PCR, RT-PCR, Sequencing

P148 Immunopotentiation of avian heterophils with microbial agonists. M. Farnell*[1], A. Donoghue[2], F. Solis de los Santos[3], P. Blore[3], B. Hargis[3], G. Tellez[3], and D. Donoghue[3], [1]*Texas A & M University*, *College Station*, [2]*USDA*, *Fayetteville, AR*, [3]*University of Arkansas*, *Fayetteville*.

The immune system of neonatal chicks is functionally immature during the first week of life. Researchers have previously demonstrated that the avian humoral response can be increased through the use of probiotics. Although the humoral response provides the chick with an effective mechanism to combat pathogens, sufficient antibody titers are not attained until 7 to 10 d post infection. However, the innate immune system (i.e. heterophils) can respond much more quickly to pathogens. The objective of this study was to determine whether probiotic bacteria can also up regulate heterophil function. Heterophils were isolated from the peripheral blood of neonatal chickens by using a discontinuous density gradient. Oxidative burst and degranulation are bactericidal mechanisms used by heterophils to kill pathogens and were used in this study as indicators of heterophil function. We found that each of the 10 ″generally recognized as safe ″ (GRAS) probiotic isolates (designated G1-11) tested, in vitro, were capable of increasing ($P < 0.05$) heterophil oxidative burst and degranulation when compared to unstimulated controls. *Bacillus subtilis* (G3), *Lactococcus lactis lactis* (G6) and *Lactobacillus acidophilus* (G8) isolates were determined to elicit the greatest heterophil response in vitro and were subsequently fed to chicks. Phosphate buffered saline (PBS) or one of these three probiotic isolates (~ 2.5×10^8 cfu/chick; 50 chicks/treatment) resuspended in PBS was administered by oral gavage on the day of hatch. Heterophils were isolated from chicks from each of these four treatment groups 24 h post treatment. Significant increases in heterophil degranulation and oxidative burst were observed with the G3, G6 and G8 treated chicks when compared to heterophils isolated from birds with no probiotic treatment. These data suggest that probiotic bacteria can significantly improve heterophil oxidative burst and degranulation in broilers. To our knowledge this is the first study demonstrating a relationship between probiotics and avian heterophil function.

Key Words: Chicken, Probiotic, Heterophil, Gastrointestinal tract, Innate immunity

P149 Real-time RT-PCR for the rapid detection of avian reoviruses. K. Guo*, T. Dormitorio, and J. Giambrone, *Auburn University*, *Auburn, AL*.

Avian reoviruses (ARV) infect a variety of organs and may cause tenosynovitis, malabsorption syndrome, chronic respiratory disease, and immunosuppression in commercial poultry. Vaccination is the main method for preventing ARV infections. However, vaccine effectiveness in the field is variable due to the presence of different antigenic strains. Our objective is to develop a rapid and highly specific method for the detection of ARV strains utilizing Real-time RT-PCR technology. Using specific primer and probes sets, we want this test to detect all ARV infections in the poultry as well as identify specific serologic and pathologic types. The protocol consists of two phases of real-time RT-PCRs, which were conducted in a Roche LightCycler. In the first phase, primer-probe sets were compared and selected to detect all ARVs from North America. Here we report a best primer-probe set, which was designed from a highly conserved region of S4 gene, and its rapid, highly sensitive detection of 8 ARV strains. ARVs were also detected with this test from clinical samples, which were previously found to contain ARVs by other tests. The second phase of the project, the development of primer-probes sets for the detection of serologic or pathologic strains, is in progress.

Key Words: Avian Reovirus, Real-time RT-PCR, Detection

P150 Comparison of mean death time in eggs from several velogenic Newcastle disease virus strains, isolated in Mexico from 1997 to 2006. R. Merino* and N. Calderon, *Universidad Nacional Autonoma de Mexico*, *Mexico City, Mexico*.

Newcastle disease (ND) has major importance in poultry around the world. Exotic ND is responsible for high mortality rate and international commerce restrictions. The objective of this study was to use the mean death time in eggs (MDTE) to compare the virulence of 16 ND virus strains isolated at the UNAM between 1997 and 2006 and the Mexican reference strains Chimalhuacan and Queretaro. All strains were grown in commercial chicken embryo (CCE) and the minimum lethal dose (MLD) was calculated. All strains were standardized to 10^2 MLD/0.1 ml, inoculated into ten 11-day-old embryonating eggs, incubated a 37°C and candled at 2-4 hours intervals. The time at which each embryo was first observed as dead was recorded. The MDTE was compared by ANOVA, $P<0.05$. All 16 strains were identified as velogenic, since the MDTE was lower than 60 hours, except for one isolate from 1998 (MDTE = 61.5 hours). The Mexican reference velogenic strain Chimalhuacan showed a very high virulence (MDTE=39.7 hours, ab), only one isolate from 2005 was similar to it (MDTE= 37.4 hours, a); 11 isolates had MDTE between 41.7 and 48.8 hours (abcdef), including the Queretaro strain (MDTE= 43.2 hours, bc); 4 isolates had MDTE between 50.3 and 59.7 hours (efgh) and only one isolate from 1998 had MDTE= 61.5 hours (h). The Chimalhuacan strain has been previously reported as highly virulent when inoculated in susceptible chickens; according to our results, the Mexican strains of NDV show difference in their virulence, at least one of them (isolated in 2005) could be related to the Chimalhuacan strain, isolated for first time several decades ago. These results show that velogenic strains of Newcastle disease virus can be differentiated by using a standardized dose even when using commercial embryonating eggs to inoculate.

Key Words: Newcastle disease, Velogenic, Mean death time, Commercial embryonating egg, Titration

P151 *In vitro* and *in vivo* transgenic expression of Newcastle disease virus HN protein using an avian adeno-associated virus vector. F. Perozo*[1], P. Villegas[1], C. Estevez[2], I. Alvarado[1], and L. Purvis[1], [1]*Poultry Diagnostic and Research Center*, *Athens, GA*, [2]*USDA*, *Athens, GA*.

The avian adeno-associated virus (AAAV) is a replication defective non-pathogenic virus member of the family *Parvoviridae* that has been successfully used for gene delivery. The generation of recombinant AAAV virions expressing the immunogenic hemagglutinin-neuraminidase (HN) of Newcastle disease virus (NDV) and the immune response induced in chickens was assessed. The feasibility of the *in vitro* generation of the recombinant AAAV virions expressing the HN protein was demonstrated by immunohistochemistry (IHC) and electron microscopy (EM). After *in ovo* or intramuscular inoculation of the recombinant AAAV in specific pathogen free chickens, a systemic immune response measured as NDV specific antibodies detection using enzyme-linked immunosorbent assay and the hemagglutinin inhibition test was observed. Neutralizing antibodies induced by the recombinant AAAV were demonstrated by the virus neutralization test (VN) performed in embryonating eggs.

Key Words: Avian adeno-associated virus, Newcastle disease virus, Hemagglutinin-neuraminidase, Immune response

P152 Innate immune functions and intracellular signaling in wild-type and commercial turkeys. K. Genovese, H. He, C. Swaggerty, and M. Kogut*, *USDA-ARS, FFSRU SPARC*, *College Station, TX*.

The purpose of these studies was to compare heterophil innate immune functions and related intracellular signaling in a commercial line of turkeys to those in a wild-type line. Heterophil phagocytosis of *Salmonella* (SE) and two mechanisms of microbial killing, oxidative burst and cellular degranulation, were assayed. Heterophils from commercial Line A turkeys and from wild-type turkeys were exposed to SE, opsonized SE (OPSE), and PMA for 1 hour. Degranulation was detected by quantifying β–glucuronidase activity in the culture medium following stimulation of heterophils; heterophil oxidative burst was measured by oxidation of DCFH-DA to fluorescent DCF. Heterophils from wild-type turkeys had a significantly greater production of an oxidative burst and degranulation on days 4 and 7 post-hatch than did heterophils from Line A. No differences in the phagocytosis of SE were observed between lines. In signaling studies, heterophils were stimulated for 1 hr with SE or OPSE. After stimulation, cell lysates were tested for mitogen-activated protein kinase (MAPK) activity. Specifically, phosphorylation of extracellular signal-regulated protein kinase (ERK1/2) and p38 MAPK were assayed using commercially available ELISA kits. Total protein tyrosine kinase (PTK) activity was assayed. On both day 4 and day 7 post-hatch, heterophils from Rio Grande turkeys had significantly higher levels of ERK 1/2 and p38 MAPK kinase activity upon stimulation with either SE or OPSE($p< 0.001$). PTK values on day 4 and 7 in Rio Grande turkey heterophils was significantly higher upon stimulation with SE than with OPSE and was significantly ($p<0.001$) higher than the PTK levels in Line A upon SE and OPSE stimulation. In combination, these results show that heterophils from wild-type turkeys function more efficiently than do heterophils from commercial Line A turkeys and that the inefficiency of cellular function observed in heterophils from Line A turkeys may be associated with defects or insufficiencies in the intracellular signaling mechanisms related to the innate immune response.

Key Words: Turkey, Heterophil, MAP kinase, Protein tyrosine kinase, Innate immunity

P153 T-RFLP analysis of the gastrointestinal of broilers affected and unaffected with gangrenous dermatitis. K. Bos*[1], T. Neumann[1], D. Ritter[2], and T. Rehberger[1], [1]*Agtech Products, Inc.*, *Waukesha, WI*, [2]*Mountaire Farms of Delaware, Inc.*, *Millsboro, DE*.

The gastrointestinal (GI) tract of a commercial broilers harbors a dense and metabolically active microbial community. This GI community has been shown to play a large role in animal performance and health status. Recently, gangrenous dermatitis (GD) has reemerged as a significant concern for poultry producers in the United States. One theory states that GD comes from pathogenic bacteria present in the GI community. GD can be treated with antibiotics, but the effects of these antibiotics on the GI microbial community are poorly understood. Classically, traditional plating methods are used to characterize microbial populations. Unfortunately, these techniques are limited in their ability to detect only cultivable microorganisms. The objective of this study was to use terminal restriction length polymorphism (T-RFLP) to: assess the GI microbial community in GD affected and unaffected birds both with and without antibiotic treatment, and

determine bacteria that are unique to each health status. GI tracts from broilers with and without GD symptoms in the same house were collected from farms in Delaware. Genomic DNA was isolated from the mucosal bacteria of the duodenum, jejunum, and ileum of each bird, and analyzed by T-RFLP to characterize the GI communities. Comparisons of terminal restriction fragment (TRF) patterns from the affected and unaffected birds indicated which TRFs appeared to be associated with diseased or healthy status. GD treatment with antibiotics altered the microflora within the GI community in a similar manner in both affected and unaffected birds. These bacterial changes are different than the changes seen in the affected and unaffected birds that had not received an antibiotic treatment. The preliminary identification of the bacteria associated with GD indicated by the TRFs are Clostridial spp., *Mycoplasma* spp. or phytoplasmas, and *Pasteurella* or *Actinobacillus* spp. While the bacteria associated with a nondiseased health status are *Lactobacillus* spp. Overall, T-RFLP has been an effective tool to monitor changes within the GI community of broilers both affected and unaffected by GD, with and without antibiotic treatment.

Key Words: T-RFLP

P154 RAPD comparison of *Clostridium perfringens* isolated from cases of necrotic enteritis and gangrenous dermatitis. T. Neumann*, S. Dunham, J. Skalecki, and T. Rehberger, *Agtech Products, Inc.*, *Waukesha, WI*.

Clostridial diseases have become a major concern in today′s poultry industry. Accompanied by high mortality and reduced efficiency they often inflict a heavy economic burden on producers. Necrotic enteritis and gangrenous dermatitis are among the most common clostridial diseases observed in broiler chickens. The anaerobic, spore-forming bacterium *Clostridium perfringens* is recognized as the causative agent of necrotic enteritis and has also been implicated in gangrenous dermatitis. This opportunistic pathogen is capable of producing a myriad of extracellular toxins and enzymes that degrade host tissues and are responsible for the necrotic lesions observed. RAPD PCR is a technique that can be used to generate a molecular fingerprint of a bacterial species or strain. These fingerprints can then be compared to determine the relationship among the organisms. The purpose of this study was to use RAPD PCR to determine if strains of *C. perfringens* isolated from cases of necrotic enteritis and gangrenous dermatitis are similar. Fourteen broilers showing signs of gangrenous dermatitis were collected for microbiological analysis from an East coast production system. Twenty-two broilers with necrotic enteritis from both East coast and West coast farms were also examined. A total of 153 *C. perfringens* isolates were recovered for the study. All of the isolates were confirmed as type A by a multiplex PCR that amplifies the four major toxins (α, β, ε and iota). Fingerprints generated by RAPD PCR were used to construct a dendrogram in order to study the relationship among the strains. Necrotic enteritis isolates from East and West coast sites clustered separately from gangrenous dermatitis isolates. However, East coast necrotic enteritis isolates were more related to East coast gangrenous dermatitis isolates than West coast necrotic enteritis isolates. These results show that geographic location is an important source of genomic variability in strains of *C. perfringens* type A.

Key Words: Necrotic, Enteritis, Gangrenous, Dermatitis, *Clostridium*

P155 Evaluation of combined sulfonamide activity toward *pasteurella multocida* and *Escherichia coli* using *In Vitro* disk assays. J. Mathers* and S. Clark, *Alpharma Animal Health*, *Fort Lee, NJ*.

The soluble product PoultrySulfa™ is comprised of sulfamethazine, sulfamerazine, and sulfaquinoxaline at a 2:2:1 ratio, and is approved for use as an aid in controlling acute fowl cholera caused by susceptible *Pasteurella multocida* in chickens and turkeys, as well as an aid in controlling coccidiosis in chickens. An evaluation of the constituents of PoultrySulfa™ versus commercial and lab-prepared disks was made, to demonstrate activity versus poultry-derived *P. multocida* and *E. coli* and to compare with a commercial triple sulfa disk. Disks were prepared in the lab for sulfamethazine, sulfamerazine, sulfaquinoxaline, sulfadimethoxine, and PoultrySulfa™ at 0.25 mg per disk. A commercial SSS-25 disk (BD Diagnostics™, #231349) was run for comparison. Fourteen *P. multocida* strains and four *E. coli* were grown overnight and evaluated for disk susceptibility using standardized 6.5 mm diameter disks on Mueller-Hinton agar and incubation at 35ºC. The inhibition zone diameters for *E. coli* were within expected QC ranges. For *P. multocida*, the SSS disk had the best zone diameter correlation with the lab PoultrySulfa™ disk (r=0.831) in comparison to the individual sulfonamides (r=0.329-0.809).

Key Words: Sulfonamide, Fowl cholera, Coccidiosis, PoultrySulfa™, Disk assay

P156 Serotyping of *Escherichia coli* isolates from an integrated poultry company in Mexico. G. A. Ramírez Barrera[1], A. Navarro Ocaña[2], C. Eslava Campos[2], and C. Rosario Cortés*[1], [1]*Aves, FMVZ, UNAM.*, *México, D.F, Mexico*, [2]*FM; UNAM*, *México D.F, Mexico*.

Escherichia coli is a common and important bacterial pathogen that causes at least 5% of the mortality in poultry flocks. Consequently, these bacteria are responsible for significant economic losses to the poultry industry. Pathogenic serogroups of *E. coli* are ubiquitous in environments in which poultry are raised and can cause air sacculitis, pericarditis, peritonitis, salpingitis, synovitis, osteomyelitis, cellulitis or yolk sac infections (YSI). Despite the enormous knowledge about Avian Pathogenic *E. coli* strains exists around the world, in Mexico few information is available. Recently, some articles have reported the characteristics about Mexican strains of *E. coli*. The objective of the present work was to analyze Mexican strains of *E. coli* isolated from a different company from the previously reported in order to determine the serotypes implicated in collibacilosis in Mexico. Ninety seven strains were isolated from samples obtained from Breeder Flock, Hatchery and Broiler Farm. All samples were seed onto MacConkey-Lactose agar, and Blood agar and incubated at 18 hours at 37 ° C. Lactose positive strains were selected. Biochemical testing, and serotyping of *E. coli* were performed. The main serogroups identified were O? (19.58%), O20 (10.30%) O8 (7.21%), O131 (7.21%) and O25 (6.18%). These results did not correspond with those previously reported where the most important serogroups were O19 (12%), O84 (9%), O8 (6%) and O78 (5%). This data suggest that *E. coli* strains associated with collibacilosis in Mexico are diverse and it is necessary to perform further studies to determine the pathogenic properties of each group.

Key Words: *Escherichia coli*, Serotyping, Mexico, APEC

P157 Colicin production in *E. coli* strains isolated from a integrated poultry company in Mexico. S. I. Valencia García and C. Rosario Cortés*, *UNAM*, *México, D.F. Mexico*.

Recently, *E. coli* strains pathogenic to avian species have begun to be grouped as Avian Pathogenic *Escherichia coli* (APEC). Aside from causing embryo mortality, some common features of APEC strains including the production of colicin V, have also been described. Col V, an 88 amino acid polypeptide, is one of the most common among 20 known colicins. At present, Col V is not considered to be a pathogenic feature by itself. In a recent definition of pathogenicity; however, it was proposed that any trait that increases the proliferation or survival of a bacterium during the infection process could be classified as a virulence factor. Thus, Col V production could possibly be considered as a virulence trait since it contributes to the elimination of competing microorganisms. Moreover, it is known that plasmids that encode for colicins also contain genetic information for other virulence factors. The objective for this paper was analyzed the colicin production in *E. coli* strains isolated from a case of collibacilosis in a integrate company located in the Mexican State of Querétaro. Ninety seven strains were isolated from samples obtained from breeder flock, hatchery and broiler farm. All samples were seed onto MacConkey agar, and Blood agar and incubated at 18 hours at 37 ºC. Biochemical tests to detect E. coli were performed. A technique for colicin detection were also performed. Forth phenotypes can be distinguished with the technique: 1) No production of colicins, 2) Production of Col V, 3) Production of Col V and other colicins and 4) Production of colicins different from Col V. The largest group was composed by those strains that produced colicins different from Col V (38.14%), followed by strains that produced Col V and other colicins (28.86%), No colicin producers (25.77%) and strains that only produced Col V (7.21 %). These results suggest that the strains associated to collibacilosis in Mexico are diverse since these results are different from those previously obtained. To better understand the importance of this feature in collibacilosis it is necessary to look for other virulence markers encoded in colicin plasmids.

Key Words: Colicin, *Escherichia coli*, Poultry

P158 Environmental management issues of arsenic in poultry litter. S. Burgos Cáceres*[1] and S. A. Burgos Cáceres[2], [1]*North Carolina State University*, *Raleigh*, [2]*University of Guelph*, *Guelph, ON, Canada*.

Arsenic is a notoriously potent poisonous metalloid used as a component of pesticides, herbicides, insecticides and various alloys. Ingestion of arsenic, both from water supplies and animal tissues, has been scientifically linked as a potential cause of skin, liver, lung, kidney and bladder cancer. It can kill by allosteric inhibition of an important metabolic enzyme (lipothiamide pyrophosphatase) leading to multi-system organ failure, revealed post mortem by red colored mucosa due to severe hemorrhage. Poultry feedstuffs, mainly broilers, can contain trace amounts of arsenic in the form of organoarsenical feed additives such as Roxarsone for its growth-promoting and disease-controlling properties, especially to combat coccidiosis. Disposal of the resulting arsenic-bearing poultry litter is currently unregulated, and it is frequently used to fertilize croplands. Excessive manure applications as an alternative organic fertilizer coupled with abundant irrigation or torrential rains can lead to arsenic leaching and contamination of waterways. On January 22, 2001 the U. S. Environmental Protection Agency adopted a new standard for arsenic in drinking water at 10 ppb, replacing the old standard of 50 ppb, through which all production systems must comply with the new standard by January 23, 2006. Faced with stricter federal regulations and an increasingly demanding customer base, the poultry industry must reassess the implications of managing arsenic levels in poultry wastes. Europe's ban on antibiotics -fully enforced by the beginning of 2006- and current discussions of adding more feed additives that would be faced out by 2016 places increasing pressures on poultry operators desiring to further penetrate foreign markets. In the case for organoarsenical feed additives, it has been suggested that poultry farms can adopt any combination of these three alternatives: 1) completely eliminate its inclusion and replace it with a natural non-toxic alternative, 2) drastically reduce its inclusion rate in diets, and 3) creatively devise another use for poultry wastes instead of land mass applications. Goals for the future include the replacement of coccidiostats with a vaccine.

Key Words: Arsenic, Poultry, Waste, Environment, Roxarsone

P159 Bacterial levels associated with poultry litter treatment (PLT) and aluminum sulfate (Alum). K. S. Mackln*, J. P. Blake, J. B. Hess, and R. A. Norton, *Auburn University*, *Auburn, AL*.

Litter treatments are commonly used to reduce ammonia and bacterial levels. In order to determine the effects of PLT and Alum on reducing bacterial levels two experiments were conducted. Both experiments were performed using clean pine shaving litter that was placed into 16 environmental chambers (2.44 x 2.44 x 2.44 m). Chicks were placed at a density of 70 chicks/pen. In both experiments there were four treatments, with each treatment getting four pens. The treatments comprised of a control (CON) and either PLT or Alum being applied at the following rates: 50, 100 and 150 lbs/1000ft^2. Both experiments had litter collected weekly from three areas within each pen for 7-weeks. Each sample had their pH and percent moisture determined. Bacteriologically total aerobic, anaerobic, Staphylococcus, and C. perfringens levels (cfu/g) were determined and the presence or absence of Campylobacter and *Salmonella* was determined. Bacterial counts and percent moisture data were transformed using log10 and arcsine transformations, respectively. The data was analyzed using GLM with $P<0.05$ and significant means were separated using Tukey's.

The results for PLT show that with an application rate of 50 lb the pH was the same as the CON after 14 days ($P<0.05$). Both the 100 and 150 lb application rates kept the pH lower then the CON and 50 lb rate until day 49. The only difference detected bacteriologically was that the 150 lb rate had lower anaerobic bacterial numbers (11.8) then the CON (12.4) after 49 days ($P<0.05$). Alum treated litter produced a variable pH among the treatments; however the treatments that contained the highest levels maintained a lower pH ($P<0.05$) through day 49. Bacteriologically the only difference was observed at day 49 with the 150 lb Alum rate having lower anaerobic bacterial numbers (9.7) then CON (11.1) and the 100 lb treatment (11.4) at a $P<0.05$. From these results it was concluded that neither PLT nor Alum effect bacterial numbers significantly in fresh litter. The observation in reduced anaerobic numbers on day 49 at the highest application rate may imply that long term usage of these products may reduce some bacterial populations.

Key Words: PLT, Alum, Litter, Poultry, Bacteria

P160 Bactericidal effect of several chemicals on hatching eggs inoculated with *Salmonella* serovar typhimurium. N. A. Cox*[1], L. J. Richardson[1], R. J. Buhr[1], M. T. Musgrove[2], M. E. Berrang[3], and W. Bright[4], [1]*USDA, ARS*, *Athens, GA*, [2]*USDA, ARS*, *Athens, GA*, [3]*USDA, ARS*, *Athens, GA*, [4]*South Carolina State University*, *Orangeburg*.

Breeder flocks and commercial hatcheries represent an early contamination point for *Salmonella* entry into commercial integrated poultry operations. Utilizing effective antimicrobial treatments for hatching eggs is a critical part of reducing the incidence of *Salmonella* colonized chicks on the farm. The objective of this study was to evaluate the bactericidal effect of several chemicals on *Salmonella* contaminated hatching eggs. Four replications (n=10/treatment) were conducted to determine the efficacy of seven commercially available compounds. The compounds tested were A) hydrogen peroxide B) water/oil emulsion droplets stabilized by detergent C) peroxyacetic acid D) four quaternary ammonium compounds attached to a polymer E) two quaternary ammonium compounds, one biquanide compound and bronopol attached to a polymer F) N-alkyl dimethyl benzyl ammonium chloride and stabilized urea and G) polyhexamethylenebiquanide hydrochloride (PHMB). A naladixic acid resistant *Salmonella* serovar Typhimurium was inoculated (10^4 cfu/ml) onto fertile hatching eggs by drip inoculation. Controls included 1) a positive control (no spray application) and 2) water control (spray containing water to take into account rinsing effects). The E and G compounds had a 100% reduction and both of these chemicals included a biquanide. The D and C compounds were also effective with a 95% and 93.5% reduction, respectively. The B and F compounds were the least effective of all chemicals with a reduction of 40% and 47.5% respectively. Hydrogen peroxide, which has been used by the poultry industry, had a 70% reduction and the water control produced a 10% reduction. Several antimicrobials tested were more effective than hydrogen peroxide. More detailed studies will be required to adequately evaluate these antimicrobials.

Key Words: *Salmonella*, Eggs, Bactericide

P161 Efficiency of probiotics, prebiotics and synbiotics on weight increase of chickens. G. Zhang*, L. Ma, and M. P. Doyle, *University of Georgia*, *Griffin*.

With the ban of antibiotics use in animals in Europe, interests in using probiotics, prebiotics and synbiotics for controlling foodborne pathogens such as *Campylobacter* and *Salmonella* in poultry are increasing. There are numerous reports indicating that probiotics, prebiotics and synbiotics were effective in reducing *Campylobacter* and *Salmonella* colonization in poultry. Do they affect chicken growth? The objective of this study was to determine the effect of feeding probiotic bacteria, prebiotics, and synbiotics on weight gain of chickens. Probiotic bacteria (mixture CE 1 included 3 *Lactobacillus salivarius* strains, and mixture CE 2 consisted of CE1 and a *Streptococcus cristatus* strain) were isolated from healthy adult chickens. Prebiotics used were fructooligosaccharide (FOS) and lactose (2.5% in feed). Each treatment had 20 chickens. Day-of-hatch chickens of Ross x Ross were fed with probiotic bacteria at 10^8CFU/chick once by gavage (Trials 1 and 2), or at 10^6CFU/ml in drinking water for the first week except day 3 (Trial 3). On day 3, all treatment chickens were challenged with *Salmonella* Typhymurium at 10^6CFU/chick by gavage (Trials 1 and 2) or through drinking water (Trial 3). Individual chickens were weighed on day 9, 12, 15, 19, and 26. In Trial 1, treatments CE 1 only, CE2 plus FOS, CE2 only, and lactose only significantly (α = 0.05) increased body weight by 83.0 to 100.5 g/chick at day 26 in comparison with control. In Trial 2, treatments CE2 plus lactose and CE2 only significantly increased body weight by 25.6 to 27.7 g/chick at day 12; treatment CE1 plus lactose significantly increased body weight by 42.3 g/chick at day 19. In Trial 3, at day 9 all treatments except for lactose only increased body weight significantly; there was no significant difference between treatments and control in body weight at day 15. It was observed that probiotics and synbiotics were effective in increasing body weight of chickens; prebiotics alone (FOS or lactose) did not have consistent effect on body weight gain of chickens. In conclusion, the probiotics and synbiotics studied could be used to increase weight gain of chickens.

Key Words: Probiotics, Prebiotics, Synbiotics, Poultry, Weight gain

P162 Determination of ileum microbial diversity by denaturing gradient gel electrophoresis analysis of 16S ribosomal DNA amplicons of broilers fed triticale- or corn-based diets and colonized by *Salmonella*. F. B. O. Santos*[1], B.W. Sheldon[1], A. A. Santos, Jr.[1], P. R. Ferket[1], M. D. Lee[2], A. Petroso[2], and D. Smith[2], [1]*North Carolina State University*, *Raleigh*, [2]*University of Georgia*, *Athens*.

Diversity of the bacterial communities in the ileum of broilers was characterized using denaturing gradient gel electrophoresis (DGGE). DGGE separation of polymerase chain reaction (PCR) amplicons of the V2-V3 variable regions of the 16S rDNA is a common method to profile community diversity and has been used to assess the effects of diet and antibiotics on the ileal bacterial community of chickens. Broilers raised either in a litter house or in a non-litter cage system were fed either a finely ground corn- (control), a finely ground triticale- or a whole triticale-based diet from 0-42 d. Microbial DNA was extracted from the ileum content of 42 d broilers and the 16S rDNA gene was amplified by PCR and the amplicons separated by DGGE. Diversity indexes including richness, evenness, diversity, and pairwise similarities coefficient were calculated. Diversity indexes were related to the dietary treatments, housing designs and with changes in *Salmonella* populations of broiler ceca as characterized by the most probable number method (MPN). Higher microbial diversity indexes were observed among birds fed whole triticale-based diets and reared in the litter house. In contrast, finely ground grain treatments had lower microbial diversity and were more heavily colonized by *Salmonella* than the whole triticale treatment. The combination of higher dietary fiber content and increased coarseness of the diet by feeding whole triticale presumably stimulated microbial community diversity and discouraged *Salmonella* colonization through a competitive exclusion type mechanism.

Key Words: *Salmonella*, Broilers, Microbial diversity, Triticale, Whole grain

P163 Genotype analysis of *Campylobacter* spp. isolated from various internal organs of commercial broiler breeder hens. K. L. Hiett*[1], N. A. Cox[1], L. J. Richardson[1], R. J. Buhr[1], P. J. Fedorka-Cray[2], J. S. Bailey[2], and J. L. Wilson[3], [1]*USDA, ARS, PMS*, *Athens, GA*, [2]*USDA, ARS*, *Athens, GA*, [3]*University of Georgia*, *Athens*.

Campylobacter spp. are presently believed to be the leading bacterial etiological agent of acute gastroenteritis in the human population. Evidence implicates poultry as a significant source of the organism for human illness; however, the pathways involved in *Campylobacter* spp. contamination of poultry flocks remain unclear. In an effort to further understand the dissemination of naturally occurring *Campylobacter* spp. through commercial broiler breeder hens, *Campylobacter* spp. isolates previously recovered from the primary and secondary lymphoid organs, liver/gallbladder, and ceca of broiler breeder hens were genotyped using flagellinA Short Variable Region (*flaA*-SVR) DNA sequence analysis. In general, two predominant subtypes were recovered from each flock (representing four different age groups) tested. Interestingly, the flocks tested at 22 and 66 weeks of age revealed two distinct subtypes, that upon further analyses, were determined to delineate into species specific (*C. jejuni* or *C. coli*) subtypes. Isolates that grouped in the *C. jejuni* specific subtype (all isolates recovered from week 66) were recovered from the liver/gall bladder, spleen, and thymus. However, this group did not contain any isolates recovered from the ceca. Isolates that comprised the *C. coli* specific subtype (recovered during weeks 22 and 66) were originally recovered from all locations tested. This investigation demonstrates that similar subtypes of *Campylobacter* spp. are naturally present within the internal organs of the bird′s body. Further delineation of the initially observed difference in recovery locations between *Campylobacter* species is needed.

Key Words: Broiler Breeder, *Campylobacter*, Genotype, Internal organ

P164 Internal and external carriage of inoculated *Salmonella* in broilers during growout. J. A. Cason*, R. J. Buhr, L. J. Richardson, and N. A. Cox, *Russell Research Center*, *Athens, GA*.

Internal and external persistence of inoculated *Salmonella* and spread to uninoculated chicks in the same pens were studied by sampling ceca and rinses of feathered carcasses in two experiments. Half of the day-old chicks in pens were orally inoculated with a nalidixic-acid-resistant strain of *Salmonella Typhimurium* at three levels of inoculum (0.1 mL delivering approximately 4.0 × 102, 104, or 106 cfu). At 3, 6, and 8 weeks of age, equal numbers of inoculated and non-inoculated birds were electrocuted and rinsed in 400 mL of diluent, after which ceca were removed aseptically, with a total of 652 chickens sampled in the two experiments. There were no differences in *Salmonella* incidence between inoculated and non-inoculated birds at any age, so the marker *Salmonella* was well distributed within pens. Total incidence was 70%, 86%, and 83% at the 102, 104, and 106 inoculum levels, respectively. Considering both cecal and rinse samples, incidence was 81%, 84%, and 72% at 3, 6, and 8 weeks of age respectively. There were 95 positives in the cecal samples only, 149 positives in the rinses only, and 275 positives in both ceca and rinse samples, so sampling ceca alone underestimated the total incidence of the marker *Salmonella*.

Key Words: *Salmonella*, Growout, Sampling, Whole carcass rinse, Ceca

P165 Cumulative ammonia quantification from litter with instantaneous flux estimates. D. M. Miles*[1], D. E. Rowe[1], P. R. Owens[2], P. A. Moore, Jr.[3], and D. R. Smith[4], [1]*USDA-ARS Waste Management & Forage Research Unit*, *Mississippi State, MS*, [2]*Purdue University*, *West Lafayette, IN*, [3]*USDA-ARS Poultry Production and Product Safety Research Unit*, *Fayetteville, AR*, [4]*USDA-ARS National Soil Erosion Laboratory*, *West Lafayette, IN*.

Challenges, such as method viability and litter heterogeneity, persist in measuring NH_3 emitted from broiler housing. A chamber acid trap (CAT) system was designed to investigate NH_3 generation. The objectives of this work were to assess the variability of litter generated NH_3 using the CAT system and compare the CAT quantification of NH_3 to instantaneous (i-) flux estimates. Commercial litter, reusing pine shavings bedding, was collected prior to flock 19. The bulk sample was homogenized and randomly assigned in 50 g increments to each of 48 chambers. The CAT system provided approximately 100 ml/min of air to each 1000 ml chamber which exhausted into a series of two flasks containing boric acid. On selected days, the boric acid was titrated with HCl to assess NH_3 volatilization. The i-flux method inverted a 1.98 L container over a 93.8 cm^2 tray (chamber footprint) containing a litter sample. At roughly 2 min intervals, a photoacoustic gas analyzer drew in (and returned) the gas sample from the head space of the inverted container to determine NH_3 concentration. The CAT cumulative NH_3/chamber collected after 1 d averaged 9.05 ± 0.58 mg N and 52.40 ± 1.36 mg N on d 16. The cumulative NH_3 release was predicted as (mg N) = 15.7 ln(day) + 7.16, with R^2=0.99. Converting the cumulative NH_3 from the CAT experiment to flux units (mass/area/time) gave estimates of 40 mg m^{-2} h^{-1} on d 1 and 15 mg m^{-2} h^{-1} on d 16. The i-flux procedure indicated 54 mg m^{-2} h^{-1} at 2 min and 29 mg m^{-2} h^{-1} after 8.5 min. An NH_3 reduction over time is expected; the results indicate that the time selected for flux greatly impacts the magnitude of an estimate. Therefore, extreme care would be required to apply flux calculations in regulatory circumstances. The CAT system offers a viable method for lab-scale NH_3 volatilization mechanistic studies (effects of various physical/chemical/biological or systematic modifications). The relationship of cumulative NH_3 and i-flux requires further characterization, but promise exists for developing predictive models and correlation between the two methods to provide rapid assessment protocols for litter management as regulations for air quality emerge.

Key Words: Ammonia, Broiler, Flux, Litter

P166 Dietary lactose and its effect on the disease condition of necrotic enteritis. J. L. McReynolds*[1], J. A. Byrd[1], K. J. Genovese[1], T. L. Poole[1], S. E. Duke[1], M. B. Farnell[2], and D. J. Nisbet[1], [1]*USDA-ARS-Food And Feed Safety Research Unit*, *College Station, TX*, [2]*Texas A&M University*, *College Station*.

Clostridium perfringens (CP) is the etiologic agent of Necrotic enteritis (NE) and is ubiquitous in nature. The incidence of NE has increased in poultry flocks that have stopped using antibiotic growth promoters. The mechanisms of colonization of CP and the factors involved in onset of NE are not fully understood. Previously, our laboratory has demonstrated that lactose could potentially reduce *Salmonella* and CP in ceca of poultry. In the present investigation, we hypothesized that dietary lactose would reduce the clinical signs of NE and could be used as an alternative to antibiotics. In Exp. 1, day-of-hatch broilers were fed either a non-lactose control diet, a diet with 2.5% lactose, or a diet with 4.5% lactose throughout the experiment. Birds were administered CP (10^7 cfu/mL) daily via oral gavage for three consecutive days starting on d 17. When evaluating the intestinal lesions associated with

NE, birds fed 2.5% lactose had significantly lower ($P \leq 0.05$) lesion scores (0.70 ± .52) compared to the control (1.55 ± .52) or the 4.5% lactose (1.60 ± .52). Microbial analysis suggest that lactose did not affect bacterial populations during the 21d evaluation. In a replicate experiment the overall lesion scores in, were significantly ($P > 0.05$) reduced in birds fed 2.5% lactose compared to the birds fed the control diet with mean lesion scores of 1.10 ± .73 and 1.80 ± .73 respectively. These experiments suggest that lactose could be used as a potential alternative to growth promoting antibiotics to help control this costly disease.

Key Words: *Clostridium perfringens*, Chickens, Lactose, Necrotic enteritis

P167 Use of stochastic modeling to predict prevalence of *Salmonella* postitive broilers entering the processing plant. D. E. Cosby*[1], J. S. Bailey[1], C. L. Hofacre[2], D. Cole[3], M. Finklin[2], and B. J. Turner[2], [1]*USDA*, *Athens, GA*, [2]*University of Georgia*, *Athens*, [3]*Georgia Dept. of Human Resources, Division of Public Health*, *Atlanta, GA*.

In the U.S. salmonellae are responsible for approximately 15% (approximately 40,000 cases per year) of all food borne illnesses and improperly handled or undercooked poultry and eggs are often identified as a source of salmonellosis in humans. Since chickens are a major carrier for salmonellae, determining the prevalence of contaminated chickens entering a plant has become a priority in order to decrease the cross contamination of poultry products exiting the plant. Samples were collected from six individual houses on individual farms and the associated flocks at the processing plant from a single local integrator. On farm (boot socks, drag swabs, litter composites, cloacal swabs, ceca and carcass rinses) and in-plant (ceca and carcass rinses) samples were evaluated to determine the relationships between *Salmonella* prevalence on the farm to that found in the processing plant. Prevalence data was analyzed using Spearman correlation coefficients and regression to determine relationship between on farm data and plant data. Using the data collected, a stochastic model (Crystal Ball 7Â®) was developed to predict the prevalence distribution of *Salmonella* spp., contaminated birds entering the plant. Boot socks showed the strongest correlation with plant carcass rinses (r=0.7882), and cloacal swabs were most predictive of plant ceca (r=0.8111), although neither was significant at α=0.05.

Key Words: *Salmonella*, Prevalence, Stochastic Modeling, Broilers, Processing

P168 Collagen type X and transforming growth factor β-1 in tibia bones are affected by incubation conditions in broilers and turkeys. J. Small*, E. O. Oviedo-Rondón, M. J. Wineland, V. L. Christensen, D. T. Ort, K. M. Mann, M. D. Koci, and S .L. Funderburk, *North Carolina State University*, *Raleigh*.

Previous research in our lab has suggested that temperature (T) and oxygen (O_2) concentrations during the plateau stage of incubation affect several aspects of bone development. Collagen type X (colX) and Transforming Growth Factor β-1 (TGFβ-1) are key indicators of the hypertrophic chondrocyte development and may have implications in tibial dyschondroplasia and other bone disorders. This experiment aimed to evaluate the effects of T and O_2 concentrations during the plateau stage on the activity of colX and TGFβ-1 in tibia bones of broilers and turkeys at day of hatch. Two experiments were conducted with broilers and two with turkeys, under similar conditions, to evaluate either 4 T (36, 37, 38 or 39 °C) or 4 O_2 concentrations (17, 19, 21 or 23% O_2). Two strains of chickens with low (LG) and high (HG) eggshell conductance, and one turkey strain of LG were evaluated in all experiments. In each experiment, standard incubation conditions were used for broiler eggs up to 17 days and turkey eggs up to 24 days. At day of hatch 10 chicks or poults per strain were randomly selected. Legs were dissected and tibias fixed for histological analyses by immunofluorescense. Cell density (cellD) in each zone of the growth plate was calculated in slides stained with H&E. Results indicated that high T depressed the fluorescence of colX and TGFβ-1 in turkeys and chickens. This effect was more pronounced in the LG chicken strain. O_2 concentrations do not affect consistently the fluorescence of these proteins. CellD in the resting zone was increased ($P<0.05$) by the high T in the incubator independently of genetic strain. Temperature also increased cellD in the P zone, but this effect varied according to the genetic line. CellD was not affected ($P>0.05$) by T in the H zone, but both chicken strains had significantly different number of chondrocytes in this area. We concluded that high incubation T may reduce the presence of colX and TGFβ-1 in chicken and turkey tibiotarsus with deleterious effects for bone development.

Key Words: Bone, Broilers, Turkeys, Collagen type X, TGF β-1

P169 Influence of lighting program, temperature, and strain on physiological stress and fear responses of broilers. L. B. Hooie*, R. J. Lien, and J. B. Hess, *Auburn University*, *Auburn, AL*.

Broilers of two strains were exposed to light and temperature treatments to evaluate effects on heterophil to lymphocyte ratio (H:L), plasma corticosterone, and tonic immobility duration (TI). Fifty males of moderate (MY) and high yield (HY) strains were placed by strain in 2 pens in each of 12 rooms. Six rooms were provided bright-long (2 FC; 23L:1D) and six rooms dim increasing (0.1 FC; 20L:4D, 1-10 d; 12L12D, 10-21 d; 15L:9D, 21-28 d; 18L:6D, 28-35 d; 20L:4D, 35-55 d) light treatments. Beginning at 35 d, six rooms were exposed to typical temperatures (avg. daily high of 27C and low of 21C) and six rooms were subjected to cool temperatures (avg. daily high of 24C and low of 17C). Treatments and strains made up a 2 by 2 by 2 factorial arrangement.

At 53 d, H:L was unaffected by temperature but affected by a light treatment by strain interaction (P=0.08) in which the MY strain had increased H:L in the bright-long treatment and decreased H:L in the dim-increasing treatment; whereas, HY strain H:L were intermediate and unaffected by light treatment. Differences in plasma corticosterone at 33 d and 53 d were not significant but followed the same pattern as H:L. At 32 d, TI was significantly greater in the bright-long treatment and HY strain. At 49 d, TI was affected by a 3 way interaction in which the bright-long treatment decreased TI, except in the MY strain at typical temperatures. However, the dim-increasing treatment increased TI, except in the MY strain at typical temperatures. These results indicate that common lighting program and temperature differences may influence stress and fear responses of broiler strains differently.

Key Words: Broiler, Lighting program, Stress, Welfare, Tonic immobility

P170 Evaluation of one hydrogen peroxide disinfectant in floor eggs. V. D. Gonzalez-Reyes, G. Gómez-Verduzco, J. A. Quintana-Lopez, and O. Urquiza-Bravo*, *National University of Mexico*, *Mexico City, Mexico*.

All egg qualities are recognized as its structure and as a production unit, reason why today there are more exigencies in production.

Within the productive system there are many handling practices to obtain a free microorganisms product who could cause alteration like manual egg collection and the geographic location. On the other hand, the disinfection has had success in the destruction of present germs in shell surface without damage in the cuticle, and also no damage in the personnel who is applying it. Of products used in the disinfection of the fertile egg it appears the hydrogen peroxide (H_2 O_2), which has demonstrated to be effective in the destruction of the microorganisms. It offers the advantage as fast evaporation or destruction (it is become in H_2 O and O_2), does not leave scents disagreeable and it is not harmful to the people who apply it. That is why the objective of this work was to evaluate an hydrogen peroxide disinfectant in floor eggs, by external and internal bacteriological sampling, before and after the use of a disinfectant with hydrogen peroxide. 42 eggs from breeder Hy Line W 36 hens were collected from the Medicine Veterinary Faculty experimental farm of the National University of Mexico (UNAM). Each egg was washed with a phosphate buffered solution for an external bacteriological sampling before and after the application of the disinfectant and decimal serial dilutions were made to be plating in solid cultures. Later yolk was collected and it was plated in the same cultures. The application of hydrogen peroxide had a significant reduction ($P<0.01$) compared to eggs with no disinfectant.

Key Words: Disinfectants, Hydrogen Peroxide, Floor Eggs

P171 The effect of egg shape and weight variation on hatchability and hatch of fertile in commercial broiler breeder flocks. J. R. Moyle*, D. E. Yoho, R. S. Harper, A. D. Swaffar, and R. K. Bramwell, *University of Arkansas*, *Fayetteville*.

Commercial breeder and hatchery managers have become increasingly concerned with the perceived variability of hatching eggs produced by modern broiler breeder hens. However, there is little published data in reference to the size and shape variation of broiler breeder eggs and the effect on hatchability. This study evaluated the variability in the weight and shape of eggs produced by hens of different flocks, ages and strains. Broiler breeder hatching eggs utilized were from commercial hatcheries representing different flocks, ages and strains. Individual egg weights were obtained to determine the variation within each flock. After obtaining egg weights, hatching eggs were separated by weight for that flock and returned to the commercial hatchery trays for incubation. To evaluate egg shape variation, dividing the width of each egg by its length created an egg shape index. Each egg was assigned a shape score value between 0-13 based upon this index. All eggs were incubated in commercial hatcheries by weight or shape group and a complete embryo diagnosis of the hatch residue performed. All data were analyzed using JMP statistic software comparing egg weight groups and egg shape index for differences in hatch traits. While there was no significant difference in hatchability between the heavy and average weight eggs for each flock, the light weight eggs from each group had as much as 9% lower hatchability. Additionally, eggs assigned a shape index score that fell outside the normal curve for that flock had significantly reduced hatch of fertile (as much as 22.3% lower hatch for the more oblong eggs as compared to the normal shaped eggs). In summary, hatchability of fertile eggs within a flock is affected by the weight and shape variation within that flock with the lighter and more oblong eggs suffering higher embryo mortality as compared to the average size and shape eggs for that flock.

Key Words: Hatching egg weight, Hatching egg shape, Egg uniformity

P172 Effects of temperature variation in on-farm hatching egg holding units in commercial broiler breeder flocks. D. E. Yoho*[1], S. Henderson[1], A. D. Swaffar[1], S. Martin[2], and R. K. Bramwell[1], [1]*University of Arkansas*, *Fayetteville*, [2]*Cobb-Vantress, Inc.*, *Siloam Springs, AR*.

Hatching egg storage conditions have been evaluated in the past and recommendations presented to receive optimum hatchability. However, most commercial broiler breeder farms on-farm egg storage facilities are not capable of consistently maintaining the optimum storage conditions needed to maintain embryo viability. Therefore, this study was designed to study the effects of fluctuations in on-farm egg storage temperatures on hatchability and embryo livability in commercial broiler breeder flocks. Hatching eggs were obtained from commercial breeder farms the day of lay and prior to their placement in the existing on farm egg storage facilities. Hatching eggs were transported to egg storage facilities and were randomly divided into five groups of 288 eggs per group. Egg storage chambers were maintained at 66, 68, 70, 72 or 74^0 F. All eggs were initially stored for 24 hours at 70 F (21.1 C) with the control eggs remaining at 70 F for three days. After 24 hours storage, equally sized groups of eggs were moved to either two or four degrees below or above the control group. Following this 24-hour period the eggs in the high and low temperature chambers were switched to the alternate high or low temperature group. These temperatures were selected to maintain an average of 70 degrees for all eggs for the three-day storage period. Eggs were then returned to a commercial hatchery for incubation. Following the incubation process, eggs from each treatment were subjected to a complete hatch residue breakout to determine percent hatch and hatch of fertile and embryo mortality. All data were analyzed using JMP statistical analysis program. Fluctuation of on farm egg storage temperatures reduced hatch and hatch of fertile by 3.6% and 2.9%, respectively. In summary, oscillating on-farm egg storage temperatures can cause a significant loss in hatchability.

Key Words: Hatching egg storage, On-farm egg storage, Hatchability

P173 Efficacy of the clay adsorbent, SOLIS™-BASE, in ameliorating the toxic effects of aflatoxin in broiler chicks. H. Choudhury[1], L. B. Linares*[1], R. E. Kutz[1], D. R. Ledoux[1], G. E. Rottinghaus[1], A. J. Bermudez[1], R. B. Shirley[2], and F. A. Uraizee[2], [1]*University of Missouri*, *Columbia*, [2]*Novus International, Inc.*, *St. Louis, MO*.

An experiment was conducted to determine the efficacy of the adsorbent SOLIS™-BASE, in ameliorating the toxic effects of aflatoxin (AF) in broiler chicks. A second objective was to determine the minimum

level of AF that would depress chick performance. Two hundred and fifty day-old male broiler chicks were assigned to a 2 x 5 factorial arrangement of dietary treatments (5 pens of 5 chicks/treatment) from hatch to day 21. Factors were level of adsorbent (0 or 0.2% SOLIS™-BASE) and concentration of AF (0, 0.75, 1.5, 2.25 or 3 mg AF/kg of diet). The addition of SOLIS™-BASE to chick diets at a level of 0.2% did not negatively affect ($P > 0.05$) chick performance, organ weight, or toe ash weight. Feed intake (FI) and body weight gain (BWG) was depressed ($P < 0.0001$) in chicks fed dietary AF concentrations of 1.5 mg AF/kg diet and higher. Feed intake depression ranged from 13 to 33%, whereas BWG gain depression ranged from 9 to 37%. The addition of SOLIS™-BASE to the AF contaminated diets ameliorated the effects of AF on FI (range 5 to 21%) and BWG (range 2 to 20%). Relative liver and kidney weights were higher in chicks fed AF ($P < 0.0001$), and the addition of SOLIS™-BASE to the AF-contaminated diets reduced ($P < 0.05$) the increase in the weight of both organs. Toe ash weights were lower ($P < 0.0001$) in chicks fed AF, and the addition of SOLIS™-BASE to the AF-contaminated diets increased ($P < 0.008$) toe ash weights. Results indicate that SOLIS™-BASE at 0.2% of the diet did not negatively affect chick performance, and was effective in reducing the toxic effects of AF. Data also indicate that a dietary concentration of 1.5 mg AF/kg diet was enough to depress chick performance.

Key Words: Aflatoxin, Adsorbent, Broiler chick, SOLIS™-BASE

P174 Effect of dietary energy and dietary protein in corn-soy diets on post-molt performance,egg components,egg solids and egg quality in phase 1 molted Hyline W-36 hens. P. Gunawardana*, G. Wu, M. M. Bryant, and D. A. Roland, *Auburn University*, *Auburn, AL*.

A 4 × 3 factorial experiment using four added dietary energy (fat) levels [0 (0.00), 79(1.67), 158(3.35) and 238(5.04) kcal ME/kg(%fat) and three protein levels (14.89,16.06 and17.38%) was conducted to determine the influence of dietary energy on performance, egg composition, egg solids and egg quality of Hy-line W-36 hens fed different protein levels. The basal diets of the 17.38, 16.06 and 14.89% protein contained 2751, 2784 and 2815 kcal ME/kg, respectively. This study lasted 12 weeks. Molted Hy-line W-36 hens (n=1440) phase 1 (70weeks of age) were randomly divided into 12 treatments (8 replicates of 15 hens per treatment).Protein had a significant effect on feed intake, Increasing dietary protein linearly increased feed intake from 93.15 to 98.75g/hen/day,resulting in a 6.01% increase of feed intake. Protein also had a significant effect on egg production, egg specific gravity, egg mass, feed conversion, egg weight, percentage of egg shell components, egg yolk color and yolk and albumen weight. Increasing dietary energy by addition of poultry oil also had a linear effect on feed intake at all three protein levels. As added dietary energy increased from 0 to 158 kcal ME/kg, feed intake linearly decreased. However a further increase of added dietary energy from 158 to 238 kcal ME/kg, had no additional effect on feed intake. Increasing dietary energy had a significant effect on egg specific gravity, body weight of hens, feed conversion and egg yolk color. There was a significant interaction between protein and dietary energy on egg specific gravity, percentage of egg yolk solids and egg yolk color. Increasing dietary energy and protein significantly improved feed conversion. Increasing protein intake significantly increased albumen and yolk weight but had no influence on yolk albumen or whole egg solids.

Key Words: Protein, Dietary energy, Hens

P175 Effect of dietary energy, protein and a versatile enzyme in corn-soy diets on hen performance, egg solids, egg composition and egg Quality of Hy-Line W- 36 hens during phase two second-cycle. P. Gunawardana*, G. Wu, M. M. Bryant, and D. A. Roland, *Auburn University*, *Auburn, AL*.

A 4 x 2 x 2 factorial experiment of four energy levels and two protein levels with and without Rovabio was conducted to evaluate the effect of Rovabio Excel, dietary energy and protein on performance, egg composition, egg solids, and egg quality of commercial Leghorns. Hy-line W-36 hens (n=1920, 87wk old) were randomly divided into 16 dietary treatments (8 replicates of 15 hens per treatment). The trial lasted 12 weeks. Protein had a significant effect on feed intake, body weight, yolk solids, and yolk color. As dietary energy increased from 2,792 to 2,990 ME/kg, feed intake linearly decreased from 97.96 to 94.90 g per hen daily, resulting in a 3.1% decrease of feed intake.Added dietary energy had a significant linear effect on daily TSAA and lysine intake, with increase of added dietary energy from 0 to 198 kcal/kg, TSAA and lysine intake decreased by 3.09%. There was a linear response of body weight of hens to increased dietary energy. Dietary energy had a significant effect on yolk solids and yolk color. Egg weight of hens fed the diets supplemented with Rovabio was significantly higher than that of hens fed the diets without Rovabio during wk 3 and 4, and was numerically higher than that of hens fed the diets without Rovabio during other weeks. Rovabio supplementation significantly increased body weight of hens. These results suggest Rovabio had a significant influence on energy utilization of commercial Leghorns during phase 2 of second cycle. More research is needed with Rovabio in young hens to evaluate performance and profits of commercial layers at different egg and ingredient prices.

Key Words: Rovabio, Energy utilization, Hen

P176 The effect of exogenous xylanase on dietary energy, N and amino acid metabolism when included in wheat-based diets and fed to layers. V. Pirgozliev*[1], T. Acamovic[1], O. Oduguwa[1,2], and M. R. Bedford[3], [1]*Scottish Agricultural College, ASRC*, *Edinburgh, United Kingdom*, [2]*University of Agriculture*, *Abeokuta, Nigeria*, [3]*Syngenta Animal Nutrition Inc.*, *Marlborough , United Kingdom*.

Wheat is an important source of energy and amino acids in poultry feed throughout the World. However, the cell walls in wheat are mainly composed of non-starch polysaccharides (NSPs) that may posess antinutritive activity increasing digesta viscosity and reducing bird performance. Exogenous xylanases are enzymes that cleave the NSPs in wheat and reduce their negative effect on the performance. Most published data relates to broiler production and there is a lack of information on the effect of xylanases in layer diets and especially on the effects on dietary energy, nitrogen (N) and amino acid (AA) metabolism. Although energy relates mainly to growth performance, the metabolism of N and AA has also a significant environmental impact. To examine the effect of a novel xylanase (Quantum, Syngenta Animal Nutrition) on performance, dietary energy, N and AA metabolism, five wheat-based diets (control (C), C + 400, + 800, + 1200, + 1600 XU (xylanase units/kg feed)) were fed to eight hundred and ten Lohmann Brown laying hens (28-32w age) in 270 cages (3 birds in a cage). Xylanase supplementation improved N metabolisability and the intake of metabolisable N by 6.3% ($P=0.015$) and 4.2% ($P<0.001$) respectively. The metabolisability coefficients for total and dispensable amino acids also improved ($P<0.05$) by 7.2% and 6.5% respectively.

Dietary xylanase increased (P=0.019) sulphur metabolisability by approximately 2% suggesting an improvement in the utilisation of S-containing amino acids. Dietary AME tended (P=0.152) to increase with enzyme supplementation. Feeding xylanase also improved (P<0.05) the market quality of the eggs increasing the yolk colour and decreasing the number of blood spots. The results of this study showed that dietary xylanase improved the egg quality as well as the metabolisability of N and AA in diets of laying hens thereby reducing adverse environmental impacts.

Key Words: Xylanase, Layers, Amino acids, Egg quality

P177 Requirements for true digestible isoleucine, threonine, and tryptophan for 28 to 36-week-old laying hens. S. Roberts[1], B. Kerr[2], D. Hoehler[3], and K. Bregendahl*[1], [1]*Iowa State University*, *Ames*, [2]*NSRIC, USDA/ARS*, *Ames, IA*, [3]*Degussa*, *Kennesaw, GA*.

Three separate experiments were conducted with Hy-Line W-36 hens to evaluate the true digestible (TD) Ile, Thr, and Trp requirements for egg production (EP), egg weight (EW), egg mass (EM), and feed efficiency (FE). The experiments were conducted simultaneously and were each designed as a randomized complete block design with 60 experimental units (each consisting of 1 cage with 2 hens) and 5 dietary treatments. The treatment diets consisted of a common basal diet (2987 kcal/kg ME; 12.3% CP), formulated using corn, soybean meal, and meat and bone meal. The TD amino acid contents in the basal diet were determined using the total fecal collection precision-fed assay with adult cecectomized roosters. Crystalline L-Ile, L-Thr, and L-Trp (considered 100% TD) replaced cornstarch in the basal diet to yield TD contents of 0.37, 0.50, 0.64, 0.78, and 0.92% Ile; 0.38, 0.45, 0.53, 0.60, and 0.67% Thr; and 0.09, 0.13, 0.17, 0.21, and 0.25% Trp. Crystalline amino acids were added to the test diets at the expense of cornstarch to make the respective test amino acid first limiting. The hens were fed the treatment diets from 26 to 34 wk of age, with the first 2 wk considered a depletion period. EP was recorded daily; EW was determined weekly on 48-h eggs; whereas EM (= EP × EW), feed intake (FI), and FE (= gram EM per gram feed consumed) were recorded weekly. The requirements were determined using the broken-line regression method. The daily FI of hens fed amino acid–adequate diets was 83 g/hen. The maximum responses for EP (%), EW (g), EM (g/hen), and FE (g/g) were 90.5, 53.2, 48.1, and 0.586 for Ile; 93.3, 53.4, 49.8, and 0.588 for Thr; and 91.7, 53.1, 48.7, and 0.573 for Trp; respectively. The daily requirements for maximum EP, EW, EM, and FE were 427, 394, 426, and 415 mg/hen for TD Ile and 400, 418, 414, and 461 mg/hen for TD Thr, respectively. The daily TD Trp requirements for maximum EP, EM, and FE were 119, 120, and 95 mg/hen, respectively. EW was not affected (P > 0.05) by Trp consumption.

Key Words: Amino acid requirements, Laying hens

P178 An adjustable nutrient margin of safety comparison using linear and stochastic programming in an Excel spreadsheet. W. B. Roush*, J. L. Purswell, and S. L. Branton, *USDA-ARS Poultry Research Unit*, *Mississippi State, MS*.

With the diversion of corn to the biofuel industry, it will be necessary to use feed ingredients that have highly variable nutrients. Stochastic Programming is a nonlinear programming approach to constrain risk when dealing with nutrient variability. The use of a margin of safety was suggested by Nott and Combs (1967) as a method to adjust the nutrient matrix to compensate for nutrient variability. To make the adjustment, they suggested subtracting one half of a standard deviation from the mean value of nutrients. This would increase the probability of meeting an animal's requirement from 50% for a LP to 69% for a LP. Pesti and Seila (1999) illustrated how linear programming (LP) and stochastic programming (SP) could be formulated in an Excel spreadsheet program. They used two different scenarios, one showing LP and the other showing SP. The intent of this research is to build upon the work of Pesti and Seila by demonstrating a comparison of LP and SP based on the linear problem proposed in their paper. An Excel workbook was developed consisting of two spreadsheets for LP and SP, respectively. Both approaches use the Solver function for optimization. Ingredients and nutrients were based on the formulation problem for the LP in Pesti and Seila and served as a benchmark for development of the two programs. Standard deviations for energy and the nutrients calculated from CVs, (Zhang,1999) and from the commercial publication of sources for amino acids (Degussa, 2001). The conclusion was that the Excel spreadsheet effectively demonstrated the difference in accuracy and precision of SP versus LP in least cost formulations at a requested risk constraint. At the 50% level of risk, both programs produced the same ration formulations as was expected. At the requested 69% level of risk, the linear program formulated a ration with a 77.26% level of risk while the stochastic program formulated the requested level of 69%. The 77.26% produced a higher cost ration than the 69% stochastic ration.

Key Words: Feed formulation, Linear programming, Stochastic programming

P179 Influence of microbial phytase on true phosphorus digestibility in canola meal fed to broiler chicks. A. Akinmusire* and O. Adeola, *Purdue University*, *West Lafayette, IN*.

Using canola meal (CM) as a model ingredient, our objectives in the study were the application of the regression analysis technique to estimate true P digestibility (TPD) in broiler chicks and the quantification of microbial phytase influence on TPD. Two hundred and eighty eight male broiler chicks were assigned to 6 dietary treatments from day 15 to 21. Experimental diets fed consisted of three graded levels of CM with or without phytase supplementation (a total of six semi-purified and isocaloric diets) in a 3×2 factorial arrangement. Sequential diets formulated with CM (diets 1 through 3) were calculated to contain 1.06, 2.11, and 3.17 g of phytate P/kg of diet respectively. Diets 4 through 6 were identical to diets 1 through 3; except for the addition of Phyzyme XP phytase at 1,000 units (FTU)/kg. Chromic oxide was added to the diets, and P digestibility was calculated using the index method. As dietary P increased from 1.74 to 4.94 g/kg DM and from 1.65 to 4.84 g/kg DM for the phytase unsupplemented and supplemented diets, respectively, total P output in prececal digesta and total P output in excreta expressed on a dry matter intake basis linearly increased (P < 0.01). In addition a clear positive effect (P < 0.01) of phytase was observed in the total P output in prececal digesta and total P output in excreta. Estimated true prececal P digestibility was observed to differ (P < 0.01) between CM without phytase and with phytase (68 vs. 78% respectively). Phytase supplementation equally resulted in a difference (P < 0.01) between true total tract P retention (36 vs. 44%). It may be concluded from this study that approximately

68 and 36% of total P in CM could be digested and absorbed by growing chicks as measured from the prececal digesta and total tract excreta respectively; and that the addition of microbial phytase at 1000 U/kg significantly increases this true prececal P digestibility and true total tract P retention value to approximately 78 and 44% respectively.

Key Words: Canola meal, Chicks, Phosphorus, Phytase, True digestibility

P180 Implications of dietary threonine on crude mucin excretion in broiler chicks and ducklings. N. Horn* and O. Adeola, *Purdue University*, *West Lafayette, IN*.

The effect of dietary threonine on crude mucin excretion was investigated in male broiler chicks and White Pekin ducklings. Seventy-two birds of each species were fed a standard poultry starter diet from day 0 to day 14, then assigned to 3 dietary treatments in a randomized complete block design for a 7-day feeding trial. The dietary treatments consisted of a semipurified isonitrogenous corn-soy bean meal based diet with the addition of crystalline amino acids and graded levels of threonine. Dietary treatments contained approximately low (0.33g/kg), medium (0.58 g/kg), and adequate (0.82 g/kg) levels of threonine based on NRC recommendations. Chromic Oxide was added to the dietary treatments as an indigestible marker. Excreta was collected from day 5 to day 7 of the feeding trial, immediately frozen, and later freeze dried and analyzed for crude mucin. For broiler chicks there was a tendency for linear increase in growth performance ($P < 0.10$) for the 7 day feeding trial, and there were linear increases in dry matter retention ($P < 0.001$) and crude mucin excretion ($P < 0.05$) in response to dietary threonine. For ducklings there were linear increases in growth performance ($P < 0.01$), dry matter retention ($P < .001$), and a tendency for a linear increase in crude mucin excretion ($P < 0.10$) in response to graded levels of dietary threonine. In conclusion, dietary threonine affected dry matter retention, and crude mucin excretion in broilers, whereas in ducklings, growth performance, dry matter retention, and crude mucin excretion were affected. Dietary threonine clearly has implications in regards to dry matter retention, and may be a significant factor in mucin production, with consequences on nutrient absorption in chicks and ducklings.

Key Words: Chick, Duck, Growth, Mucin, Threonine

P181 Enzymatic process of feather meal for improved digestibility. B. E. Spencer*[1], W. C. Huang[1], J. J. Wang[2], and J. C. H. Shih[1], [1]*North Carolina State University*, *Raleigh*, [2]*BioResource International, Inc.*, *Morrisville, NC*.

Feather meal is typically produced by processing feathers by batched or continuous cooking under 130-140°C steam pressure for 30-40 min followed by drying and grinding. As a feed ingredient, feather meal, with a protein content of 85-90%, is underutilized due to its poor digestibility. A preparation of keratinase (KE, 300,000 U/gm), a feather-degrading enzyme, was tested to process feather meal with improved digestibility and nutritional value. An ANCO-Eaglin 133L pilot-scale batch cooker with internal agitator (25 rpm) was used for the study. Feather meal was produced in the lab by mixing 5 kg raw feathers with 6 L of water or buffered solution and cooking at 141°C for 30 minutes, followed by a 5 min vent drying. The final products were dried overnight at 70°C and ground. To test the KE effect, four kinds of feather meal were produced: FMc (control), produced by the standard procedure using water, FMb, produced by using buffer solution (pH 8.0), FMKE5, and FMKE50, cooked with buffered solution and cooled to 60°C, followed by adding KE at 0.1% and 1.0% (w/w = KE: feathers) respectively. The cooked feathers were incubated for 30 minutes at 50-60°C with agitation, dried for an additional 48 hrs at 60°C and ground. Different preparations of feather meal were analyzed using 0.02% pepsin digestion, OPA soluble protein assay and HPLC amino acid analysis. With enzyme treatments, the protein digestibility determined by pepsin and OPA assays showed significant improvement from an average of 52% to 72% for FMKE5 and to 69% for FMKE50. Crude protein levels, as determined by Kjedahl nitrogen, were highest for FMc at 90.0% and lowest for FMKE50 at 87.8%. Lysine levels were lowest in the FMc at 1.77% and highest in FMKE50 at 1.94%. Methionine levels were equal within 0.03% for all treatments. Cysteine levels were lowest in FMc at 4.89% and highest for FMKE5 at 5.72%. KE treated feather meals demonstrated better in vitro digestibility when compared to both the water and the buffer controls. Further analysis will include animal studies for the correlation of amino acid digestibility and nutritional value of the enzymatically processed feather meal.

Key Words: Feather meal, Hydrolysis, Enzyme, Keratinase, Amino acid digestibility

P182 Impact of Availa® /M on growth, feed conversion, femur spiral fracture related mortality, bone morphometrics and carcass yield in tom turkeys. T . Cheng* and T. Ward, *Zinpro Corporation*, *Eden Prairie, MN*.

A total of 900 Nicholas Strain 88 commercial toms were randomly placed into 36 pens. The treatments consisted of (1) Sulfates [100 ppm Zn from $ZnSO_4$ and 110 ppm Mn from $MnSO_4$]; (2) Availa-Z/M ON TOP [Availa-Z/M supplied 40 ppm of Zn and 40 ppm of Mn in additional to their respective $ZnSO_4$ sources]; (3) Availa-Z/M ISO [Availa-Z/M replaced 40 ppm Zn and 40 ppm of Mn from their respective $ZnSO_4$ sources]. No significant difference among the treatments were observed for the final body weight at 140 days of age (20.08, 19.95 and 19.81 kg, respectively). The cumulative feed conversion from the Availa-Z/M ON TOP and Availa-Z/M ISO groups were significantly better than that of the Sulfate group (2.639, 2.575 and 2.568; $P = 0.15$). Overall mortality was not statistically affected by treatments but the Availa-Z/M groups showed numerically lower 106-140 day mortality (7.1, 3.7 and 4.4%) and significantly lower percentage of mortality due to spiral fracture of femur bone (43, 10 and 3%; $P = 0.05$) when compared to the Sulfate group. The Availa-Z/M groups had numerically better breast meat yield (30.83, 31.03 and 30.94%). The long-axis diameter of femur at one third of femur length from the top was significantly longer in the Availa-Z/M groups (19.58, 20.23 and 19.89 mm; $P < 0.01$). The Availa-Z/M groups produced numerically larger cross sectional average of cortical bone wall area when compared to the sulfate group (101.55, 104.07 and 103.60 mm^2). Feeding Availa-Z/M to turkeys improved bone morphometrics, reduced femur spiral fracture related mortality as well as late mortality, improved feed conversion and increased carcass weight and breast meat yield.

Key Words: Zinc, Manganese, Turkey, Femur spiral fracture, Performance

P183 A workbook to estimate parameters for nutritional response models. G. Pesti* and D. Vedenov, *University of Georgia*, *Athens*.

Experiments to determine nutritional requirements result in a set of ordered pairs of data consisting of the inputs and outputs. The inputs are various levels of the nutrient in question, and the outputs are response criteria like growth, feed utilization efficiency, carcass yield, measures of bone strength, etc. A Microsoft Excel (One Microsoft Way Redmond, WA 98052 USA) workbook has been prepared to fit several nutritional response models to experimental input/output data. The workbook, called "NRM.xls" and a tutorial on its use are available free of charge at (http://pubs.caes.uga.edu/caespubs/ES-pubs/RB440.htm). NRM.xls attempts to find the best parameter estimates for seven common nutritional models: the Broken Line (ascending linear or quadratic segments), Saturation Kinetics, three and four-parameter Logistics, Compartmental, Sigmoidal Exponential, and Exponential Models. Excel has a built-in module called "Solver" that in used in NRM.xls to minimize the sum of squared errors by changing the values of the parameter cells. In addition to parameter estimates, spreadsheets for each model also calculate the standard errors and 95% confidence intervals for the estimated parameters, as well as goodness of fit (R^2) values of the fitted models.

Each spreadsheet allows for up to 100 pairs of observations to be either entered manually or copied and pasted. Users can modify initial parameter estimates manually to achieve a "visual" fit of each regression model to the data. The "visual" fits result in good starting values for the numerical optimization algorithm and make it easier for the program to find the global minimum SSE and best parameter estimates. Knowing the confidence interval in the requirement estimate or response line enables researchers to determine the value of the experiment. Small confidence intervals suggest adequate replication and reproducible results.

Key Words: Requirement, Modeling

P184 Undergraduate teaching laboratory: Hens age, induced molting and storage effects on egg size and quality. G. M. Pesti*, R. I. Bakalli, and M. Y. Shim, *University of Georgia*, *Athens*.

The objectives of this laboratory exercise are 1) to demonstrate the changes in egg quality that occur during the life cycle of hens laying commercial eggs; and 2) to demonstrate the influence of egg storage time and conditions on changes in egg quality. We have been able to consistently demonstrate significant differences with HyLine W-36 leghorn : 64 young pullets (average age at start = 18.25 weeks) and 126 hens, half of which were molted (average age at start = 73.5 weeks). Birds were housed one per cage with 8 cages per replicate and 8 replicates per treatment. Two weeks before the end of experiment 12 eggs were randomly collected from each replication and half each were kept refrigerated (5 ºC), and at room temperature (20-24 ºC). Parameters measured/calculated include: egg weight, egg specific gravity, Haugh units (HU), relative weight of yolk and albumen, relative egg shell weight, egg shell surface, egg shell index, egg shell thickness, and egg weight decrease. Molted hens produced fewer, but 1.56 g heavier, eggs than un-molted hens (67.14 vs. 65.58, P>0.05). Positive significant effects were observed in specific gravity for molted hens, un-molted hens, and pullets (P=0.0007; 1.084^{a}, 1.079^{b}, and 1.088^{a} g/cm ^{3}, respectively) and HU (P<0.001; 79^{b}, 67^{c}, and 95^{a}, respectively, P<0.05). Significantly different egg shell surface was observed only between old and young hens. There were no significant differences between treatments in yolk or albumen relative weights, relative egg shell weights, or in shell index or egg shell thickness. Egg weight loss for molted hens, un-molted hens, and pullets was significantly different only in eggs kept refrigerated (P=0.0335; 0.78 ^{a}, 0.97 ^{ab}, and 1.21 ^{b}%, respectively). Haugh units remained better for eggs from young hens kept refrigerated (P<0.0001) as well as for eggs kept in room temperature (P<0.0001). The laboratory exercise described allows students to learn how molting, hens age and storage conditions significantly influence on egg size and quality.

Key Words: Laboratory exercise, Leghorn, Molting, Storage, Egg quality

P185 Nutrient digestibility in broilers with inclusion of inulin in the diet. J. A. Hernández Lara*[1], M. E. Juárez Silva[1], F. Pérez-Gil Romo[1], and D. Ortega Alvarez[2], [1]*Instituto Nacional de Ciencias Médicas y Nutrición Salvador Zubirán*, *México, D.F, México*, [2]*Megafarma S.A. de C.V*, *México, D.F, México*.

The use of inulin in the diet of chickens as an alternative of using antiobiotics has improved performance and enzymatic activity in the intestinal lumen. Results about the effect of inulin on starch and protein digestibility make available information to design strategies to follow on broilers feeding. The objective of this study was to determine the effect of inulin on apparent digestibility of starch and protein during the first 3 weeks of life. 10 experimental units were used for every treatment, formed by 2 Ross chickens, being the treatments: 0.0%, 0.1%, 0.2% and 0.4% of inulin in the diets with a base of maize-soya. Samples were taken on day 7, 14 and 21 of age, Cr2O3 was included in food as a marker to determine digestibility. Results of starch and protein digestibility showed improvement on day 7 with inulin concentration of 0.4%, while for day 14 and 21 the highest values were obtained with 0.2%. A positive lineal relationship between inulin concentration and digestibility for both nutrients on day 7; for day 14 the relationship stayed only for protein; and for the last period this relationship was negative for both nutrients. These results indicate that inulin concentrations to improve starch and protein digestibility during the first 21 days of chicken's life are 0.4% for the first week and 0.2% for the second to third week.

Key Words: Iinulin, Digestibility, Prebiotic, Starch, Protein

P186 Supplementation with MINTREX® organic trace minerals enhances intestinal health and feed efficiency of turkey poults. D. Bohórquez*[1], A. Santos[1], P. Ferket[1], and J. Richards[2], [1]*North Carolina State University*, *Raleigh*, [2]*Novus International, Inc.*, *St. Charles, MO*.

Dietary MINTREX Pse (MIN, Novus) and 25-hydroxycholcalciferol (HYD) supplementation may improve feed efficiency by enhancing intestinal health through mucosal characteristics. Day-old Nicholas toms were randomly distributed within 12 replicate pens (15 poults/pen) per treatment (TRT) and fed diets that met or exceeded NRC recommendation until 21d. TRT were a 2x2 factorial (0 and .1% MIN; 0 and

92 mcg/kg HYD). The .1% MIN provided 40 ppm Zn, 40 ppm Mn, and 20 ppm Cu as methionine hydroxy analogue complex and .3 ppm Se as Se yeast. All the diets contained similar trace minerals levels (150 ppm Zn, 150 ppm Mn, and 145 ppm Cu). Body weight (BW) and cumulative feed:gain (cFCR) were determined at 21d of age. At 7d, ileum histomorphometry (10 villi/bird) were measured (10 poults/TRT). Villus height (VH), apical width (VAW), basal width (VBW), crypt depth (CD), muscularis depth (MD) and mucosal height (MH) were determined. Villus height-crypt depth ratio (V/C) and apparent villus surface area (VS) were calculated. At 21d, there were no TRT effects on BW, yet a significant MINxHYD effect on cFCR revealed that MIN significantly reduced cFCR only in combination with HYD (1.321 vs 1.301, p<.05). At 7d, significant MINxHYD effects were observed on CD, MD, and V/C. MIN increased CD (42.9 vs 62.2 mcm, p<.01), increased MD (63.4 vs 97.8 mcm, p<.01) and decreased V/C (10.2 vs 7.0, p<.01) with 92 mcg/kg HYD, but not without HYD. However, HYD reduced CD (62.2 vs 42.9 mcm, p<.05), reduced MD (97.8 vs 63.4 mcm, p<.01) and increased V/C (7.0 vs 10.2, p<.05) at 0% MIN but not with .1% MIN. VBW was significantly increased with MIN supplementation (101.7 vs 116.3 mcm, p<.01), whereas VAW was decreased by HYD (70.1 vs 60.7 mcm, p<.01). MINTREX Pse supplementation for turkeys may be an effective way to improve feed conversion, likely by enhancing lateral development of the villus, especially when supplemented in combination with HYD.

Key Words: Turkeys, MINTREX, Organic trace minerals, Feed efficiency, Gut health

P187 Reduction of *Salmonella* shedding of commercial broilers flocks of North Carolina farms by dietary wheat and enzyme supplementation. A. A. Santos Jr*, P. R. Ferket, F. B. O. Santos, and B. W. Sheldon, *North Carolina State University*, *Raleigh*.

Salmonella (SA) colonization in poultry may be influenced by the degree of competitive exclusion from enteric microflora affected by diet formulation. A study was conducted to determine the effect of inclusion of wheat to the diet and dietary enzyme supplementation on SA shedding of commercial broiler chickens (Cobb). As preliminary data (0d), fresh fecal samples were taken from 4 farms (4 houses/farm), such that each farm had broilers of different ages (7, 14, 21, 35d) and fed corn/soy-based diets. Subsequently, 1d old chicks were placed at 4 farms, fed corn/soy/wheat-based diets (whole wheat with 625EXU/kg of xylanase-blend mixed in before pelleting: 25% 1-14d; 5% 14-18d; 0% 18-35d) and fresh fecal samples were collected from these birds on 7, 14, 28 and 35d. Fecal SA prevalence and populations (Log MPN/g) were enumerated using the most probable number (MPN) procedure. Before inclusion of wheat to the diet (0d), SA was recovered from all farms and from 70% of the houses with an average of 2.18 Log MPN/g. After 7d, SA prevalence (75% house, 100% farm) and population (2.66 Log MPN/g) were not statistically different from the preliminary data (P>.05). However, SA prevalence (31% house, 50% farm) and population (1.03 Log MPN/g) were significantly (P<.05) lower at 14d than at 0 and 7d. After 10 d of dietary wheat withdrawal (28d), farm SA prevalence (75%) increased and was not statistically different (P>.05) from the levels of 0 and 7d. However, SA prevalence among the houses (38%) and population (1.29 Log MPN/g) were low and similar to the levels observed at 14d, yet different (P<.05) from the other days (0, 7, 35 d). At 35d (17d after wheat withdrawal), SA shedding increased and levels were similar (P>.05) to 0 and 7d. Additionally, 70% of the houses and 75% of farms, were SA positive with a mean fecal population of 2.25 Log MPN/g. Intestinal colonization and fecal shedding of *Salmonella* was discouraged by dietary inclusion of whole wheat and an enzyme blend containing xylanase.

Key Words: Broilers, Whole Wheat, Xylanase, *Salmonella*, Diet Formulation

P188 Effect of a new coating on the thermotolerance of a phytase product. T. Gravesen*[1], S. Dalsgaard[1], and B. Fryksdale[2], [1]*Danisco Innovations*, *Brabrand, Denmark*, [2]*Genencor International Inc.*, *Palo Alto, CA*.

Phytase is used as an animal feed ingredient globally to improve phytate phosphorus digestibility. Phytases are used in the feedmill in liquid form, applied post-pelleting or in dry form added into the feed mixer. A large proportion of the feed used in the poultry industry is manufactured via steam conditioning and pelleting processes and is therefore subjected to high process temperatures, frequently in the range 85-90°C (185-194°F). Most commercially available phytases lack intrinisic thermostability and require protection in a dry form to survive the subsequent conditioning and pelleting process. A study was carried out at the Technological Institute, Kolding, Denmark to investigate the effect of a new coating on the thermotolerance of a phytase product (Phyzyme XP; 6-phytase, EC 3.1.3.26). The study compared the uncoated phytase product (phytase P), a test coated phytase product (coated phytase P) and another commercially available coated phytase product (phytase R). The phytase products were included in feed at a dose rate of 5000 FTU/kg feed. The feed was subjected to conditioning temperatures of 90°C (194°F) or 95°C (203°F), under standardised processing conditions, representative of the feed industry: corn diet, steam conditioning time 30 seconds; inlet steam pressure 2 bar; pellet diameter 3mm. Phytase activity in the final pelleted feed was expressed as a percentage recovery of the activity in the corresponding mash feed, before processing. Recovery values at 90°C (194°F) for phytase P, coated phytase P and phytase R were 30.3%, 98.6% (SED 6.08%) and 75.1% respectively. Recovery values at 95°C (203°F) for phytase P, coated phytase P and phytase R were 22.5%, 96.3% (SED 7.32%) and 66.4% respectively. In conclusion, applying a new coating to phytase P gave acceptable thermostability up to 95°C (203°F) and resulted in 74% and 30% more phytase activity being recovered following pelleting at this temperature, compared to the uncoated phytase P and phytase R respectively.

Key Words: Enzyme, Phytase, Pelleting, Thermostability, Recovery

P189 Effects of synbiotic and phytogenic feed additives on performance and immune status in broilers. T. Steiner[1], A. Kroismayr[1], M. Mohnl*[1], R. Nichol[2], and S. Attamankune[3], [1]*BIOMIN GmbH*, *Herzogenburg, Austria*, [2]*BIOMIN Laboratory Singapore*, *Lumlukka, Thailand*, [3]*Kasetsart University*, *Kamphaengsaen Nakhon Pathom, Thailand*.

The aim of the trial was to investigate the efficacy of a synbiotic and phytogenic product in comparison to an AGP in broilers. The synbiotic preparation was based on different probiotic strains and fructooligosaccharides (FOS), whereas the phytogenic formula

contained a blend of essential oils and FOS. 2400 one-day-old Ross broiler chicks were assigned to four dietary treatments, comprising 10 replicates per treatment (5 replicates for male and 5 replicates for female) with 60 birds per replicate. The treatments were (1) negative control (NC), (2) NC + synbiotic, (3) NC + phytogenic, (4) NC + AGP (Flavomycin). The synbiotic (Biomin® PoultryStar) was applied via the drinking water on the first three days and at each vaccination, whereas the phytogenic (Biomin® P.E.P.) and AGP were added to the feed throughout the whole period. Monensin (100 g/t) was included in the starter and grower diets as anti-coccidial agent. Mash feed and water were provided ad libitum. Body weight and feed consumption were recorded on day 1, 17, 38 and 45. All birds were subjected to a vaccination program, including Newcastle Disease (ND), Infectious Bursal Disease (IBD) and Infectious Bronchitis (IB). 3 birds out of each replicate were randomly collected for taking blood samples. In these samples ND, IB, and IBD immune status on d 35 were determined by hemagglutination inhibition and ELISA test. After 45 d, performance parameters were numerically improved by supplementation of the diets with Natural Growth Promoters and AGP. Compared to the NC, synbiotic, phytogenic and AGP increased weight gain by 2.8, 4.2 and 4.5%, respectively (1894 vs. 1947 vs. 1973 vs. 1979 g, P>0.05). Gain:feed ratio amounted to 0.56, 0.58, 0.58 and 0.57, respectively (P>0.05), and mortality was 1.12, 0.53, 0.36 and 0.59%, respectively, in treatments 1, 2, 3 and 4. Compared to the NC, immune parameters indicated numerically better values in treatments 2, 3 and 4 for IBD and IB. Based on the performance parameters of the present trial, the synbiotic and phytogenic product represented equivalent alternatives to AGP in broiler production.

Key Words: Synbiotic, Phytogenic, Antibiotic growth promoter, Natural growth promoter, Immune status

P190 Evaluation of broiler performance as affected by acidifier and zinc bacitracin under field conditions. C. Lueckstaedt, T. Steiner, and M. Mohnl*, *BIOMIN GmBH*, *Herzogenburg, Austria*.

Due to recent concerns about residues in animal products and bacterial resistance to antibiotics, alternatives to in-feed antibiotics (AGP) are required. Various feed additives such as organic acids have been studied already. Many scientists reported that the inclusion of organic acids in the diet can enhance growth performance and modulate intestinal microbiota. Ban on antibiotic growth promoters creates significant opportunity for feed acidification was stated recently in a report from Frost & Sullivan. An objective of the study was therefore to test a well balanced acidifier on a sequential release medium against a commercially available AGP (Zinc Bacitracin).

The trial was conducted under field conditions in Argentina. The aim of the trial was to test a well balanced acidifier (2 kg per t of feed) against a commercial piglet diet containing Zinc Bacitracin in a dose of 0.35 kg / t. Feed and water were available ad libitum. The performance of two groups of chicken (30,000 birds in total) was evaluated. Each pen consisted of 15,000 randomly selected male and female birds (Ross line 308). They were kept in pens of 150 m length x 10 m width. The trial period lasted for 42 days, during that period pre-starter feed was given from day 1 to day 14, feed was fed from day 15 till 28 days, while the finisher feed was provided until day 42.

After 42 days broilers in the acidifier treated group were numerically heavier (2236 g vs. 2223 g for the positive control), even though this difference was not statistically significant (P>0.05). The G:F was also not statistically different (P>0.05) between the two treatments (0.51 and 0.53 for acidifier and Zinc Bacitracin, respectively). Mortality in the Zinc Bacitracin treated group was slightly reduced (2.8% vs. 3.1% for the acidifier group) but again without any statistical significance.

It can be therefore concluded, that a well defined acidifier can successfully replace an AGP, such as Zinc Bacitracin, in broiler production under Argentinian conditions.

Key Words: Acidifier, Zinc Bacitracin, Broiler, Antibiotic replacement

P191 Modeling egg weight and shell quality as functions of bodyweight, protein level, and calcium particle size. K. Choate*, R. I. Bakalli, and G. M. Pesti, *University of Georgia*, *Athens*.

One hundred forty-four Hy-Line W-36 hens, 38 weeks of age, were used over a period of five weeks to model the effects of various protein levels and limestone particle size on production parameters and egg shell quality. Six feeding treatments, each in three replicates, where applied from 38 to 43 weeks of age. The treatments included four protein levels (PL: 12.8, 14.4, 16 & 17.6%) with 3.5 % calcium and limestone with two particle size (pulverized and coarse) in three combinations: 100% pulverized, 50% pulverized (PU) and 50% coarse (CR), and 100% coarse limestone, respectively. During the last eleven days (DOT) egg production (EP), feed consumption (FC) egg weight (EWT), egg specific gravity (SG), egg shell weight (SHWT), shell surface (SHS), shell index (SHI), and egg shell thickness (SHTH) where measured daily. Hen's body weights (BWT) were measured in start and end of the experiment, difference=BWG. Dietary protein level had no had no consistent effect on EP (83±2, 86±2, 85±1, and 81±4 percent, respectively) but did significantly effect EWT (P=0.0013; 60.3^{b}, 61.1^{a}, 60.1^{b}, 61.5^{a} g, respectively), feed intake (P=0.0035; 101.7^{a}, 100.0^{ab}, 97.3^{bc}, and 94.9^{c} g/day, respectively). Body gain was significantly decreased with increased protein level (P<0.001; 0.023^{a}, 0.023^{a}, -0.040^{d}, and -0.010^{c} g, respectively). Geometric mean diameter (GMD) for pulverized limestone was 240 microns with 4.4 geometric standard diameter (GSD). Coarse limestone's GMD was 2396 microns with 1.1 GSD. Different limestone particle size did not significantly effect EWT and SHS, but significantly effected egg SG (P<0.0001, 1.081^{c}, 1.083^{a}, and 1.082^{b} g/cm^3), egg SHWT (P<0.001; 5.35^{b}, 5.54^{a}, and 5.46^{a} g, respectively), SHI (P<0.0001; 7.44^{c}, 7.68^{a}, and 7.56^{b} g/cm^2, respectively), and SHTH (P<0.0001; 0.317^{c}, 0.327^{a}, and 0.322^{b} mm, respectively). Best fit prediction equations: EWT= 73.81 - 4.37793 x PL + 0.15562 x PL^2 + 0.01885 x FC + 8.72755 x BWT + 5.00611 x BWG + .08324 x DOT; SG= 84.35 - 0.02767 x FC + 0.05286 x PU - 0.00063 x PU^2 + 0.09868 x DOT; SHWT= 4.21 + 0.006130 x PU -0.000072 x PU^2 + 0.734434 x BWT + 0.470304 x BWG.

Key Words: Calcium sources, Limestone, Particle size, Protein level, Egg quality

P192 Performance of broilers fed with and without prebiotic, probiotic and anticoccidian drugs and challenged with *Eimeria acervulina*. M. B. Cafe*, C. P. Cruz, J. H. Stringhini, L. F. Reis,

L. S. Chaves, and M. A. Andrade, *University Federal of Goias*, *Goiania, Goias, Brazil*.

A 4 X 2 factorial experiment was conducted to determine the effects of prebiotic, probiotic and anticoccidian drugs on performance of broilers challenged or not with *Eimeria acervulina* at 14 days of age with 2.4 x 10^5 oocysts per bird in oral inoculation A total of 80 Cobb male chicks were randomly allocated into a metallic battery divided in eight treatments with five replicates of ten birds each, as follows: T1) diet without anticoccidian and challenged birds, T2) diet with anticoccidian (monensin) and challenged birds, T3) diet with prebiotic (mannanoligosaccharide, MOS) and challenged birds, T4) diet with probiotic and challenged birds, T5, T6, T7 and T8 were the same treatments with unchallenged birds. The performance of the birds was evaluated once a week. The results at 21 days of age showed that weight gain, feed conversion and feed consumption of the inoculated group was worse than not inoculated birds. No statistic differences were observed among unchallenged treatments. For the challenged birds, the monensin treatment showed the best weight gain but not feed conversion and feed consumption. In conclusion, birds challenged with *Eimeria acervulina* showed worse performance, whilst birds supplemented with monensin showed better weight gain. The use of probiotic and prebiotic was not efficient to enhance the performance in birds challenged with *Eimeria acervulina*.

Key Words: *Eimeria acervulina*, Performance, Anticoccidian, Probiotic, Prebiotic

P193 Digestibility of nutrients of diet of broilers fed with and without prebiotic, probiotic and anticoccidian drugs and challenged with *Eimeria acervulina*. M. B. Cafe*, C. P. Cruz, L. F. Reis, J. H. Stringhini, L. S. Chaves, and N. S. Mogyca, *University Federal of Goias*, *Goiania, Goias, Brazil*.

A 4 X 2 factorial experiment was conducted to determine the effects of prebiotic, probiotic and anticoccidian drugs on digestibility of fat and dry matter (DM) of broilers challenged or not with *Eimeria acervulina* at 14 days of age with 2.4 x 10^5 oocysts per bird in oral inoculation. A total of 80 Cobb, male chicks were randomly allocated into a metallic battery divided in eight treatments with five replicates of ten birds each. The treatments were divided in: T1) diet without anticoccidian and challenged birds, T2) diet with anticoccidian (monensin) and challenged birds, T3) diet with prebiotic (mannanoligosaccharide, MOS) and challenged birds, T4) diet with probiotic and challenged birds, T5, T6, T7 and T8 were the same treatments with unchallenged birds. The digestibility trial was performed from 18 to 21 days and was conducted by the traditional method of total excreta collection. Fat and dry matter digestibilities were calculated. The results showed that the digestibility of DM of the inoculated group was 68.1% and for intact birds (not inoculated) 77.2%. For fat digestibility the results showed 32.9% for inoculated birds and 84.1% for not inoculated birds. Among treatments without *Eimeria acervulina* challenged the DM digestibility was not statistic ($P>0.001$) different. For fat digestibility in challenged birds the monensin treatment showed the better digestibility, 64.1%, that was statistic ($P<0.001$) better than Prebiotic, 55.2%, Probiotic, 55.2% and Without Anticoccidian, 59.4%. For not inoculated birds were observed no difference in fat digestibility among treatments. In conclusion, birds challenged with *Eimeria acervulina* decrease dry matter and fat digestibility. Birds supplemented with monensin showed better digestibility. The use of probiotic and prebiotic was not efficient to enhance the digestibility in birds challenged with *Eimeria acervulina*.

Key Words: Digestibility, Anticoccidian, Probiotic, Prebiotic, *Eimeria acervulina*

P194 Nutritional performance of broiler chickens fed diets containing GAT4601 (DP-356Ø43-5)soybean fractions. J. McNaughton*[1], B. Delaney[2], and B. Smith[2], [1]*Solution BioSciences, Inc.*, *Salisbury, MD*, [2]*Pioneer Hi-Bred International, Inc.*, *Johnston, IA*.

Soybeans plants containing event DP-356Ø43-5 (356043) were produced by insertion of the gat gene from *Bacillus licheniformis* and the *gm-hra* gene modified from the herbicide-sensitive soybean gm-als gene. The gene expression products are the glyphosate acetyltransferase (GAT4601) and GM-HRA proteins that confer tolerance to the herbicidal active ingredient glyphosate and acetolactate synthase inhibiting herbicides, respectively. Diets were produced with soybean fractions (meal, hulls, and oil) from a non-transgenic near-isoline (Control), 356043, 356043 treated with herbicides (356043+Gly/SU), and three non-transgenic commercial varieties and were fed to Ross x Cobb broilers (n = 120/treatment group, 50% M and 50% F). Starter (0-21d), Grower (22-35d), and Finisher (36-42d) commercial-type diets contained 30%, 26%, & 21.5% soy meal, respectively. Hulls and oil were added at 1.0 and 0.5%, respectively, across all diets. Pen data was collected weekly. Performance and carcass traits from broilers fed 356043, 356043+Gly/SU, and Control diets were compared to 95% tolerance intervals constructed on 99% of the population using data from broilers fed diets produced with commercial soy varieties. Differences between Control and 356043 or 356043+Gly/SU groups were evaluated at $p < 0.05$. No statistically significant differences were observed in mortality, weight gain, feed efficiency (corrected for mortalities), and carcass yields between broilers consuming diets produced with 356043 or 356043+Gly/SU soybean fractions and those consuming diets produced with Control soybean fractions. Additionally, all response variables in Control, 356043, and 356043+Gly/SU groups fell within the tolerance intervals calculated from broilers fed diets produced with the commercial soybean fractions. Based on the results from this study, it was concluded that 356043 soybean was nutritionally equivalent to Control soybean with a comparable genetic background.

Key Words: Soybeans, *Bacillus licheniformis*, GAT4601, GM-HRA, Chicken

P195 A 49 day evaluation of Bio-Mos® replacement of roxarsone in a commercially based feeding program for broilers. T. Herfel*[1], A. McElroy[1], A. Sefton[2], and C. Novak[1], [1]*Virginia Tech*, *Blacksburg*, [2]*Alltech Inc.*, *Guelph, ON, Canada*.

The inclusion of Bio-Mos as a roxarsone replacement in broilers was evaluated in a 49-day trial. Three thousand and ten broilers were randomly assigned to 1 of 5 dietary corn-soybean meal based trts (14 reps/trt). Dietary trts included a negative (NEG) and positive control (POS; NEG + 27 ppm Bacitracin MD), roxarsone trt (ROX; POS + 50 ppm of roxarsone), Bio-Mos trt (BIO; POS + 0.15 and 0.5%

Bio-Mos added during the starter and grower periods, respectively), and Bio-Mos + All-Lac XCL trt (BIO+LAC; POS + 0.2, 0.1, and 0.05% Bio-Mos during the starter, grower and finishing periods respectively and 0.25g All-Lac XCL/bird sprayed at hatchery). On day 14, 7 pens/trt were infected with Emeria maxima (3 x 104 oocysts/bird) via feed (CH). Production parameters were evaluated at feed change. Right tibias were collected (one bird/pen) on day 28 and 49 to determine bone-breaking strength. Non-challenged (NCH) birds had higher body weight gains (BWG) and lower feed conversion (F:G) from day 0 to 49 than CH birds ($P < 0.05$). Dietary trts were similar from day 0 to 49. On day 28, CH birds had shorter tibias and lower BWG than NCH birds ($P < 0.5$). Bone-breaking strength was similar for all trts. From day 0 to 35, ROX (2.07 kg; 3.23 kg) birds had lower BWG and FI than BIO (2.17 kg; 3.41 kg) and BIO+LAC (2.16 kg; 3.33 kg) birds ($P < 0.05$), while F:G was similar. Additionally, F:G improved by 4 points in BIO+LAC birds compared to BIO birds ($P < 0.05$), while BWG was similar. A trt/challenge interaction occurred from 0 to 35 days ($P < 0.05$) affecting F:G for BIO birds. BIO and BIO+LAC birds performed as well as the NEG and POS birds from 0 to 35 days. FI was depressed by supplementing roxarsone causing lower BWG, but no significant differences were noted in F:G compared to feeding Bio-Mos. Bio-Mos improved BWG compared to roxarsone by increasing FI. Bio-Mos-nor roxarsone improved production parameters compared to control fed birds in the present trial.

Key Words: Bio-Mos®, Roxarsone, Coccidia, Broiler, Performance

P196 Yucca schidigera and quillaja saponaria supplementation in broiler diets. A. Corzo*[1], M. T. Kidd[1], D. Miles[2], W. A. Dozier, III[2], and P. R. Cheeke[3], [1]*Mississippi State University*, *Misssissippi State*, [2]*USDA-ARS*, *Mississippi State, MS*, [3]*Oregon State University*, *Corvallis, OR*.

Yucca schidigera and quillaja saponaria are both rich in saponins and polyphenolic compounds, and have been associated with supplementary effects that improve livestock production with some ammonia emission reduction characteristics. Thus, a broiler study evaluated live performance, carcass characteristics, lymphoid organs, immune responses, and intestinal histology of broilers, and litter pH, N %, moisture %, and ammonia flux. Ross×Ross 708 male broilers were fed either a corn-soybean meal-poultry meal control (C) diet, the C diet plus a commonly used antibiotic (bacitracin methylene disalicylate), C diet plus supplementation with 100 ppm of yucca schidigera and quillaja saponaria (YQ), or the C diet supplemented with 150 ppm of YQ. Feeds were provided in a 3 phase program either as crumbles (0-7d/prestarter; 7-21d/starter) or pellets (21-42d/grower). Body weight at 7, 21, and 42 d was unaffected by the dietary treatments. Cumulative feed conversion was also unaffected at 7 and 21 d, but a trend ($P=0.08$) was observed at 42 d, where both YQ supplemented diets were superior along with the BMD diet when compared to the C treatment. Furthermore, the experimental treatments had superior ($P<0.01$) livability at 21 and 42 d when compared to the birds fed the C diet. Bursa and spleen relative weights were unaffected by dietary treatments. Immune responses, expressed as a primary antibody response to SRBC inoculation and % inflammation to PHAP, were not affected by the dietary treatments fed. Carcass traits were similar among treatments. Jejunal-villi length and width did not differ between the treatments fed. Litter characteristics and ammonia emission were similar across all treatments. Trends were observed in live production and livability that indicate beneficial effects of YQ supplementation in commercial broiler diets. However, further research is warranted to corroborate such results and further evaluate potential ammonia emission reductions.

Key Words: Breast meat, Broiler, Quillaja saponaria, Yucca schidigera

P197 Marine phytoplankton supplementation in broiler diets. A. Corzo*[1], M. T. Kidd[1], and W. A. Dozier, III[2], [1]*Mississippi State University*, *Mississippi State*, [2]*USDA-ARS*, *Mississippi State, MS*.

Many therapeutic attributes have been elucidated over the years to marine products and by-products. For that purpose, a study was conducted to evaluate the response of broilers to dietary supplementation with marine phytoplankton. This product, in dry form, was supplemented at 0 (control), 5,000 and 10,000 ppm to a corn-soybean meal based diet, and fed to Ross×Ross male broilers. Diets were formulated to meet or exceed NRC (1994) recommendations, and were fed in mash form as a starter (0-21 d) and a grower (21-42 d) feeding phase.

On Day 21, live performance was unaffected by marine phytoplankton supplementation with the exception of feed conversion ($P<0.05$), which was increased at 10,000 ppm when compared to the 5,000 ppm and the control group. Body weight was unaffected by dietary treatments, but the treatment with 10,000 ppm supplementation of marine phytoplankton had an increase in feed consumption ($P<0.05$) which translated into an increase in feed conversion ($P<0.01$), when compared to the control and 5,000 ppm-supplemented treatment. At Day 42, birds were processed and no differences were observed for absolute and relative weights of carcass, breast meat and abdominal fat of broilers fed the different dietary treatments. Thymus, spleen and bursa were weighed from a bird corresponding to each experimental unit, and no differences in their relative weights were observed between dietary treatments. There was a numerical increase in early livability with marine phytoplankton supplementation at Day 21 (5,000 and 10,000 ppm = 99%, control = 95.8; $P<0.16$). Further studies are warranted to explore possible benefits of marine phytoplankton supplementation in broiler diets.

Key Words: Breast meat, Broiler, Marine phytoplankton

P198 Effect of the supplementation of the yeast wall cell on the humoral and cellular immune response on commercial broilers diets. G. Gomez Verduzco*[1], M. A. Baladez Lopez[2], A. Cortes Cuevas[2], C. Lopez Coello[1], and E. Avila Gonzalez[2], [1]*National University of Mexico*, *Distrito Federal, D.F, Mexico*, [2]*National University of Mexico*, *Distrito Federal, D.F, Mexico*.

The world-wide tendency is the cattle production using only the genetics, nutrition, handling and health of the animals; reason why the manipulation of the immunological system through the inclusion on the diet of some prebiotics that function immuno-modulating effects, could be considered as an alternative for the control of diseases and the improvement in the poultry production. The yeast walls cells (YWC) have been demonstrated great amount of kindness; the control of viral infections, the resistance in the presentation of diseases, as well as to

increase the efficiency in vaccination. El objective of this study is the use of a YWC in diets for commercial broilers to evaluate the humoral and cellular immune response. A study was conducted on commercial broilers Ross x Ross, they were placed on a open floor housing and they were used with 4 treatments (diets), 1 commercial diet (CD), 2 CD + YWC, 3 CD + antibiotic and 4 CD + PCL + antibiotic. The broilers were vaccinated at 10 days age. 7 and 14 days post vaccination the serum were evaluated with the hemagglutination inhibition test and ELISA against Newcastle virus disease. The cellular immune response was evaluated with mediated cutaneous basophilic hypersensitivity by an interdigital skin test. The groups that were supplemented with YWC demonstrated an improvement in the humoral and cellular immune response. In this work the YWC have a positive immunomodulating effect.

Key Words: Yeast, Immune, Humoral, Cellular, Supementation

P199 The performance of layers fed plant-protein based diets supplemented with fish meal analogue. O. A. Alalade*[1] and A. A. Fatufe[2], [1]*University of Ibadan*, *Ibadan, Oyo state, Nigeria*, [2]*Obafemi Awolowo University*, *Ile-Ife, Osun State, Nigeria*.

The move towards the use of diets devoid of ingredients of animal origin will exacerbate the effect of anti-nutrients on bird's performance and nutrient excretion in the environment. An experiment was carried out to evaluate the effect of fish analogue supplementation on the performance of layers fed plant-protein based diets. Sixty 35-weeks old black Nera layers (1.67Â±0.02 BW) were randomly assigned to 4 treatments with 5 replicates containing 3 birds each in a cage system. Four isonitrogenous diets containing 0, 0.5, 1.0 and 1.5% fish analogue (Biogro Super 70% 5030P, Daweâ€™s Inc. USA) were formulated from a corn-soybean meal basal diet of 17.25% crude protein and 2534kcal/kg ME. Adjusting the levels of soybean meal and wheat bran equalized crude protein. From the results obtained, birds fed fish analogue supplemented diets had a slight decrease ($p<0.05$) in egg weight and egg mass compared with the control. However, differences observed in feed intake, feed efficiency, egg production and body weight gain were negligible. Egg weights were 49.5, 46.6, 45.6 and 47.4g while hen-day productions were 86.5, 82.4, 84.1 and 81.2% on 0, 0.5, 1.0 and 1.5% fish analogue respectively. Overall, the result of this experiment showed that fish meal analogue supplementation did not improve the performance of layers fed plant-protein based diets

Key Words: Layers, Fish meal analogue, Plant-protein based diet, Performance, Feed intake

P200 The use of low protein diets combined with varying levels of metabolizable energy in commercial White Leghorn hens. A. S. Parsons*, D. M. Denbow, and C. Novak, *Virginia Tech*, *Blacksburg*.

Feeding layers a low protein diet typically reduces feed intake (FI), which consequently reduces the intake of other nutrients. The objective of this study was to evaluate the effects of feeding low protein diets with different levels of energy on production parameters, egg yield, physiological status as determined by plasma amino acid levels, and FI regulation as determined by brain catecholamine levels to better understand the mechanism by which low protein diets decrease FI in laying hens. Corn, SBM and wheat midd-based diets consisted of two protein levels (high HP; 18% or low LP; 13%) and two energy levels (high HE; 2850 kcal/kg or low LE; 2780 kcal/kg). All nutrients, less protein and energy, were formulated to meet peak egg production with amino acids (Lys, Met,Thr and Trp) being similar across diets. Diets were randomly assigned to six replicate raised wire cages containing three, 24 week-old commercial White Leghorn Hens (72 in^2/hen). Diet and water were provided for ad libitum consumption from 24 to 36 wks of age. Feed intake ($P = 0.0001$) was decreased in layers fed LP independent of energy level. There was a significant interaction between dietary energy and protein and their affect on brain norepinephrine, epinephrine, dopamine, S-HIAA, HVA and serotonin levels. Brain norepinephrine was lowest in birds fed the low protein diet whereas DOPAC, S-HIAA and serotonin were lowest in birds fed the high protein diet. Brain serotonin and S-HIAA was higher in those birds fed the low protein diet, which appears to correlate with decreased FI. Furthermore, egg production ($P = 0.008$) and egg weight ($P = 0.0003$) were decreased in layers fed LP diets compared to those fed HP diets suggesting that dietary energy and nutrients were shunted from egg production for use in meeting maintenance energy requirements.

Key Words: Low protein, Low energy, Feed intake, Neurotransmitters, Laying hens

P201 Impact of ochratoxin A on broiler kidneys, associated increased levels of uric acid in blood serum and possible counteraction. V. Starkl*[1] and H. Sarandan[2], [1]*Biomin GmbH*, *Herzogenburg, Austria*, [2]*University of Veterinarian Medicine*, *Timisoara, Romania*.

This trial was performed to evaluate the impact of a combination of 500ppb ochratoxin A and 1000ppb deoxynivalenol on histopathology of kidneys and the level of uric acid in the blood serum. Additionally Mycofix® Plus was evaluated on its ability to prevent renal impact of ochratoxin A.

216 day old chickens (males and females) were randomly chosen and divided into 4 treatments. Birds in treatment 1 (T1) were fed a mycotoxin free diet. Treatment 2 (T2) consisted of a diet contaminated with 500ppb ochratoxin A and 1000ppb deoxynivalenol. Diet of treatment 3 (T3) was equally contaminated as T2 but additionally treated with 1 kg of Mycofix® Plus. Treatment 4 (T4) contained 1 kg of Mycofix® Plus and no mycotoxins.

At slaughter, on day 42, organs were examined macroscopically, yet there were no visible changes in color or signs of renal or visceral uric gout. Weights of kidneys were reported in corresponding percentages to the respective bodyweight. No significant differences were found between treatments and sexes. Kidney samples were fixed in alcohol, included in paraffin, sliced and stained using hematoxyline-eosine. No necrotic lesions were found in T1 and T4. T2 was generally more severely affected than T3. Necrotic lesions were present in T2 predominantly in the proximal tubules, showing disappearance of the tubular lumen and hypertrophy of renal glomerules with disseminated focal necrosis and vascular lesions. In T3 less affected epithelium of the proximal tubules was found and additionally it was less necrotic compared to T2 found. Determination of the level of uric acid in blood serum confirmed the damage of the kidneys. The level of uric acid in

T2 was significantly higher compared to T1, T3 and T4. This correlates very well with the severity of renal lesions in T2. Males were more affected than females.

The obtained data confirmed the negative impact of ochratoxin A on kidneys and level of uric acid and suggest that Mycofix® Plus can alleviate nephrotoxicity.

Key Words: Ochratoxin A, Nephrotoxicity, Uric acid, Deactivation

P202 Comparison of organic and inorganic trace mineral sources for growth and production of brown shell laying hens. A. H. Cantor*, J. L. Pierce, A. J. Pescatore, M. J. Ford, T. Ao, and H. D. Gillespie, *Alltech-University of Kentucky Nutritition Alliance*, *Lexington, KY*.

The effect of varying levels and sources (organic *vs.* inorganic) of trace mineral supplements on growth and egg production performance was studied using a commercial strain of brown shell laying hen (Hy-Line Brown). Eight replicate groups of 16 replacement pullets, 2 wk of age, were assigned to each of six dietary treatments, using a randomized block experimental design. Pullets were housed in cages and given *ad libitum* access to feed and tap water. Trace mineral mixes that contained Cu, Mn, Fe and Zn at 25, 50 or 100 per cent of the NRC requirements in the form of inorganic salts or proteinates (Bioplex®, Alltech, Inc.) were added to corn-soybean meal-based grower and layer diets in a 3 X 2 factorial arrangement of treatments . At 16 wk of age, the number of pullets was reduced to 12 per replicate, the pullets were transferred to layer cages (2 per cage) and switched to layer diets, and the photostimulation program was initiated. During the growing period and the first 24 wk of production, body weight was unaffected by treatments. There were no effects of mineral source and level or their interaction on overall hen-day egg production (mean = 81.5%) and shell breaking strength. Mineral level significantly ($P < 0.05$) affected per cent hen-day production during Weeks 1-4 and Weeks 21-24. However, these effects were not persistent. Significant interactive effects of mineral level X source upon egg weight were noted after 12 and 24 wk of production, but not after 8, 16, and 20 wk. Compared with the organic mineral source, per cent shell was significantly higher for the inorganic mineral treatment after 8 wk of production (9.7 *vs.* 9.5), but not thereafter. The results of this study indicated that the lowest levels of Cu, Mn, Fe and Zn supplied as inorganic salts or proteinates added to corn-soybean meals were adequate for supporting growth and production of brown shell hens.

Key Words: Laying hens, Trace minerals, Proteinates, Organic minerals, Egg production

P203 Egg production performance of pearl grey guinea fowl pullets fed diets varying in metabolizable energy and crude protein concentrations from hatch to sixteen weeks of age. S. N. Nahashon*, N. Adefope, A. Amenyenu, and D. Wright, *Tennessee State University*, *Nashville*.

This study was undertaken to assess dietary metabolizable energy (ME) and crude protein (CP) concentrations for optimum performance of pearl gray guinea fowl replacement pullets. In a 3 x 3 factorial arrangement, 540 1-day-old pearl gray guinea keets were randomly assigned to experimental diets with 2,900, 3,000 and 3,100 kcal of ME /kg of diet; each contained 20, 22 and 24% CP, respectively, from 0-8 week of age (WOA). From 9-16 WOA, experimental diets had 3,000, 3,100 and 3,200 kcal of ME/kg of diet, and each contained 17, 19 and 21% CP, respectively. At 17-22, 23-27and 28-56 WOA all experimental birds were fed the same diet at each age period which containing 3,000, 2,900 and 2,800 kcal of ME/kg of diet, respectively. The diets had 18, 17 and 16% CP, respectively. Each dietary treatment was replicated 4 times, and feed and water were provided ad libitum. Body weight were measured weekly from hatch to 16 WOA and at 28-56 WOA the experimental birds were observed for feed consumption (FC), hen-day egg production (HDEP), egg weight (EW), egg mass (EM), feed conversion ratio (FCR), internal egg quality (IEQ), shell thickness (ST) and body weight (BW) at the end of each 28-day lay period for 7 consecutive periods. Mortality was recorded as it occurred. Overall, BW gains were significantly higher ($P<0.05$) in birds fed 3,000 and 3,100 Kcal of ME/kg of diet and 24% CP from hatch to 8 WOA than other dietary treatments. Percent HDEP, EM and IEQ were higher ($P<0.05$) and FCR was lower ($P<0.05$) in pullets fed diets containing 3,000 and 3,100 kcal of ME/kg of diet than those on 2,900 kcal of ME/kg of diet at 0-8 WOA. Birds on 22 and 24% CP diets also exhibited higher HDEP, EM and lower FCR than those on 20% CP diets. However, differences in mean EW, BW and ST were not significant ($P>0.05$) among dietary ME and CP treatments. Thus, feeding 3,000-3,100 Kcal of ME/kg of diet and 22-24% at 0-8 WOA and 3,100-3,200 Kcal of ME/kg of diet and 19-21% CP at 9-16 WOA improved HDEP, EM, IEQ and FCR of Pearl Grey guinea fowl laying pullets at 28-56 WOA.

Key Words: Pearl gray guinea fowl pullets, Metabolizable energy, Crude protein

P204 Effects of paractin (14-Neo-Andro) on vaccine performance, mortality and coccidiosis in chicken. J. Hancke[1] and A. Eng*[2], [1]*Universidad Astral de Chile*, *Valdivia, Chile*, [2]*HP Ingredients*, *Bradenton, FL*.

PURPOSE OF EXPERIMENTS: In the first experiment, we are exploring the effects of using nanomolar concentration of the 14-Neo-Andro compound as feed additives to potentiate vaccine and increase cellular immune response. In the second experiment, we evaluate the effect of PARACTIN as feed additive to reduce the symptoms and mortality of coccidiosis.

MATERIAL & METHODS: New Castle: 960 chickens were divided into two groups. Group 1 (n: 480) were fed with a standard diet (Control). Group 2 (n: 480) received the same diet, but added with 28g of 14-Neo-Andro compound per ton of feed. At day 7, all chickens were vaccinated with Newcastle and at day 10 with infectious bronchitis. At day 10, 21 and 28, samples of blood serum were taken for analysis. Average Daily Gain, Feed Conversion, and Mortality rate were calculated every week. Coccidiosis: 75 chickens randomly divided into 5 groups after the first week. Group 1, control group (n:15) were fed with a standard diet as above. Group 2 to 5 (n: 15) received the same diet, but added with 14-Neo-Andro compound at different levels: 50g/ton, 100g/ton, 150g/ton, and 200g/ton after the first week. At week 3, coccidia were spread into the bedding of all coops. Blood was collected when the chickens were 2, 4 and 6 weeks of age for analysis. Chicken were sacrificed at 6 weeks for lesion scoring.

Average Daily Gain, Feed Conversion, and Mortality Rate were calculated every week.

RESULTS & CONCLUSION: Lose Dose of the 14-Neo-Andro compound was capable to significantly increase the hemoaglutination titers against New Castle vaccine by 60% to 70%, increasing cellular immunity., and lower the mortality rate (8.45% vs 11%). 14-Neo-Andro compound increase average daily gain in chickens infected with Coccidiosis, and significantly reduce mortality rate (46.66%, 33.33%, 20%, 20%, and 0%) and lesion scoring. We conclude that PARACTIN (14-Neo-Andro) is a new immuno-modulating feed addition exhibiting strong potential immuno-stimulating and anti-inflammatory properties.

Key Words: New Castle, Cellular immunity, Coccidiosis, T cell

P205 The dominance of the *Salmonella* serovar Kentucky in chickens is due to its persistence in the gastrointestinal tract of mature birds. A. A. Pedroso*, M. D. Lee, and J. J. Maurer, *University of Georgia*, *Athens*.

Recently, *Salmonella enterica* serovar Kentucky has supplanted *S.* Enteritidis and Typhimurium as the most prevalent serotype in poultry. However, *Salmonella* Kentucky is not commonly associated with human illnesses in the United States. We believe that *S.* Kentucky represents a serovar that is best adapted to colonizing and persisting in poultry, which may explain its dominance on broiler chicken farms. To test this hypothesis, an in vivo competition experiment was performed between *Salmonella* serovars Kentucky and Typhimurium. One day-old chicks were raised until 42 days of age in four separate isolator units. Animals were orally inoculated with either *S.* Typhimurium RifR (n=30), *S.* Kentucky NalR (n=30), or both serovars combined (n=30); as well as negative control birds administered saline (n=30). Small intestine, cecum, liver, spleen and feces were collected at 18, 25, 32, and 39 days after inoculation, homogenized and colony counts were recorded after grown on XLT4 containing the appropriate antibiotic. Twenty-five days after inoculation, *S.* Typhimurium numbers decreased significantly in cecum and feces (4 log10 CFU/g decline), while *S.* Kentucky numbers in the cecum remained relatively high ($1x10^4$ CFU/g). This phenomenon was observed in whether the birds were administered pure cultures or a mix of the two organisms. This suggests that *S.* Kentucky did not inhibit *S.* Typhimurium growth in vivo. In addition, *S.* Kentucky persisted in the chicken's cecum longer and at levels significantly higher than *S.* Typhimurium. These colonization dynamics could explain the spread and eventual dominance of *S.* Kentucky within poultry integrators.

Key Words: Competition, *S.* Typhimurium, Microflora

P206 Effect of probiotic treatment of chicks on phagocytosis of *Salmonella* by isolated macrophages. S. E. Higgins*, J. P. Higgins, G. F. Erf, S. N. Henderson, A. D. Wolfenden, G. Gaona-Ramirez, and B. M. Hargis, *University of Arkansas*, *Fayetteville*.

Previous data have indicated that a *Lactobacillus*-based probiotic culture (FM-B11™) is efficacious for reducing *Salmonella enteritidis* (SE) colonization within 24 h when administered within 1 h of challenge. We hypothesized that the innate immune system, specifically macrophages, may play a role in the observed reduction of colonization. In two experiments, we evaluated the ability of macrophages isolated from chicks to phagocytose SE in situ. Chicks were obtained on day-of-hatch, and two groups were challenged with SE by oral gavage (Exp 1: 2.5×10^3 cfu/chick, Exp 2: 1.4×10^3 cfu/chick) while two groups received vehicle. One h later one challenged and one unchallenged group were treated with probiotic by oral gavage, and the alternate groups received vehicle. At this time, all chicks were also injected IP with 0.5 mL of a 3% sephadex solution. Macrophages were isolated from the peritoneal cavity of chicks 24 h following injection, and cecal tonsils were collected for enrichment and determination of SE colonization. In both experiments, probiotic treatment significantly reduced cecal SE recovery incidence as compared to controls (exp.1: 12% vs 76%, exp. 2: 41% vs 100%, respectively). Macrophages were maintained in tissue culture plates overnight and then assayed for phagocytic activity. Cells were incubated with SE for 30 min, then in medium with gentamicin for 45 min to kill any extracellular SE. The cells were lysed with 10% triton in PBS, and then SE recovered (cfu) per macrophage was determined. In experiment 1, significantly ($p<.05$) more SE were recovered from macrophages derived from probiotic-treated chicks (4.28 cfu/cell) than any other treatment (control 2.10 cfu/cell, SE challenged 1.94 cfu/cell, SE challenged and probiotic treated 2.28 cfu/cell). However, in experiment 2, no significant differences between groups were observed (phagocytosis of SE was less than 1 cfu/ cell in all groups). Although not conclusive, the relatively small phagocytosis enhancement in exp. 1, and lack of observed probiotic effect in exp. 2, may suggest the macrophages are not involved in the SE prophylaxis due to probiotic treatment.

Key Words: *Salmonella*, Probiotic, Macrophage, Chick, Phagocytosis

P207 Evaluation of *in vitro* and *in vivo Salmonella* reduction potential of bacteriophages isolated from different sources. R. L. Andreatti Filho*[1], J. P. Higgins[2], S. E. Higgins[2], G. Gaona-Ramirez[2], A. D. Wolfenden[2], G. I. Tellez[2], and B. M. Hargis[2], [1]*Sao Paulo State University*, *Botucatu, SP, Brazil*, [2]*University of Arkansas*, *Fayetteville*.

Salmonella enteritidis (SE)-lysing bacteriophages (Ø) isolated from poultry or human sewage sources were used to reduce SE in vitro and in experimentally infected chicks. Cocktails of 4 different Ø obtained from commercial broiler houses (CB4) and 45 Ø from a municipal wastewater treatment plant (WT45) were evaluated. In experiment 1, an in vitro crop assay was conducted with selected Ø concentrations (10^5, 10^6, 10^7, 10^8, or 10^9 pfu/mL) to determine ability to reduce SE in the simulated crop environment (16x100mm glass tube, 2 g sterile feed, 6.5 mL saline containing Ø and SE). Following 2 h at 37 C, CB4 or WT45 reduced SE recovery by up to 1.5 or 5 log, respectively, as compared to control. However, CB4 did not affect total SE recovery after 6 h due to Ø-resistant SE growth, whereas WT45 resulted in up to 6 log reduction of SE. In experiment 2, day-of-hatch chicks were challenged orally with $3x10^3$ cfu/chick SE and treated cloacally with $1x10^9$ WT45 pfu/chick one h post-challenge, and then one h later, treated or not with a commercially available probiotic (FM-B11™). Both treatments significantly reduced SE recovery from cecal tonsils at 24 h following treatment as compared to controls, but no additive effect was observed with the combination of Ø and probiotic. In experiment 3, day-of-hatch chicks were challenged orally with $9x10^3$ cfu/chick

SE and treated via oral gavage with $1x10^8$ CB4 pfu/chick, $1.2x10^8$ WT45 pfu/chick, or a combination of both, one h post-challenge. All treatments significantly reduced SE recovered from cecal tonsils at 24 h as compared to untreated controls, but no significant differences were observed at 48 h following treatment. These data suggest that some Ø can be efficacious in reducing SE colonization in poultry during a short period of 24 h or less, but under these conditions, persistent reductions were not observed.

Key Words: *Salmonella enteritidis*, Bacteriophage, Crop assay, Probiotic, Chicken

P208 Nested PCR to detect infectious laryngotracheitis virus (ILTV). O. A. Fagbohun*, J. J. Giambrone, T. V. Dormitorio, and K. Macklin, *Auburn University*, *Auburn, AL*.

A highly sensitive nested PCR was developed to detect ILTV in the litter or from tracheas of chickens, which were vaccinated, exposed to vaccinated birds, or placed on contaminated litter. Tracheal swabs and fecal samples were taken from experimental birds or litter, and examined for ILTV DNA by conventional and nested PCR. Total DNA was extracted from the samples using Qiagen kits. Amplification of the 440bp fragment from the ILTV infected cell protein 4 (ICP4) gene was by the conventional PCR and an internal 190bp fragment was produced by the nested-PCR. Samples from unvaccinated chickens or chickens reared on non-contaminated litter were negative by both tests. ILTV gene fragments amplified by the conventional PCR were faint and sometimes absent, whereas fragments from nested-PCR were clear and always present from ILTV infected birds or contaminated litter. This new test is an improvement over the conventional PCR.

Key Words: Chickens, ILTV, Nested-PCR, Conventional PCR, Gene

P209 Interrelations of ACTH infusion and dietary electrolyte balance on physiological parameters of broiler chickens. H. Olanrewaju*[1], J. Thaxton[2], W. Dozier[1], and S. Branton[1], [1]*USDA/ARS, Poultry Research Unit*, *Mississippi State, Mississippi*, [2]*Mississippi State University*, *Mississippi State*.

The aim of this study was to compare acid-base balance in broiler chickens provided diets containing two diverse dietary electrolyte balances (DEB) administered either ACTH or saline. Diets were moderate (M; 174 mEq/kg) or high (H; 241 mEq/kg) DEB by altering Na-K-Cl based upon actual analysis. These diets were fed ad libitum from d 0 to 49 d of age. Osmotic pumps delivered 8 IU ACTH in saline/kg BW/d for 7 d or the same saline volume as used in ACTH at µL/h for 7 d. Pumps were implanted on d 35 following sample collection. Post-implantation blood samples were taken on d 42 and 49. The experiment was designed as a split plot with main unit consisting of 4 treatments with factorial treatments structure (2 ACTH treatments × 2 diets) arranged in a completely randomized design. Significant DEB × ACTH interactions ($P \leq 0.04$) were determined for pCO_2 and pO_2 at 49 d. These differences infer when the H DEB diet was fed to the control and ACTH groups that pCO_2 and pO_2 were altered, whereas when the M DEB diet was fed to the control and ACTH groups, pCO_2 and pO_2 were without change. Infusion of ACTH increased ($P \leq 0.05$) hematocrit, hemoglobin, pCO_2, corticosterone, osmolality, mean corpuscular hemoglobin concentration (McHc), and HCO_3^- and reduced ($P \leq 0.05$) pO_2, Na^+, K^+, anion gap, pH, Ca_2^+, BW, and Cl^- compared to the control group on d 42 and 49. Birds fed the H DEB diet exhibited higher ($P \leq 0.05$) pO_2 than birds provided the M DEB diet. The diet formulated to H DEB partially blocked the effect of ACTH on pO_2 and pCO_2. However, due to the increased need for O_2 to support gluconeogenic energy production, the bird responded by increased erythropoiesis. This adaptive response provided greater numbers of erythrocytes and thus a higher amount of circulating hemoglobin to deliver O_2 for metabolism. Diet formulated to the H DEB partially attenuated adaptive stress condition.

Key Words: Dietary electrolyte balance, Acid-base balance, Stress, ACTH, Broiler

P210 Effect of dietary copper source and level on in vitro nitric oxide production. E. A. Koutsos[1], V. J. Arias[1], and J. I. Cohen*[2], [1]*California Polytechnic State University*, *San Luis Obispo*, [2]*Micronutrients*, *Indianapolis, IN*.

Research has shown that dietary copper, when fed at levels above the minimum requirement can modulate intestinal physiology and immune responses in growing chickens. This research examined the response of an avian macrophage-like cell line (HD11 cells) to plasma from broiler chicks fed no supplemental copper (8 mg/kg diet; control), Copper Sulfate (188 mg/kg diet; CS) or Tri-basic copper chloride (188 mg/kg diet; TBCC). HD11 cells were cultured with 10% heterologous serum, and the nitric oxide (NO) response was measured in response to lipopolysaccharide (LPS). The initial level of NO in media was greater for TBCC vs. control or CS treatment ($p<0.01$; 0.4% difference); however, the level of NO (24h and 48h post-LPS) was greater for the control and CS vs. TB treatment ($p<0.01$; 50% difference). Subsequent in vitro trials (same in vivo trial serum) examined 4 combinations of TBCC and control serum. NO responses after LPS were reduced as the proportion of TBCC plasma increased ($P<0.01$; $R2=.93$). Serum was then obtained from another in vivo broiler trial and experiments were run again. HD11 cells incubated with 100% TBCC plasma had a higher NO response at 48 h post-LPS as compared to those incubated with control plasma ($p<0.05$). Additionally, plasma was collected from birds treated with LPS in vivo, and with no in vitro stimulation, NO levels were significantly greater from control plasma than from TBCC plasma (34.2 umol/106 cells vs 18.8 umol/106 cells; $p<0.05$). These data demonstrate that copper source affects in vivo plasma parameters such that the NO response to LPS stimulation is altered. Additionally, macrophages cultured with TBCC had a dampened NO response (duration and/or magnitude) compared to macrophages cultured with control or CS plasma.

Key Words: Copper, TBCC, Nitric oxide

P211 PCR-based assay for the differentiation of *Pseudomonas* spp. isolated from poultry. I. Hanning*, A. O'Leary, and M. Slavik, *University of Arkansas*, *Fayetteville*.

The Pseudomonads are the predominate bacteria on spoiled poultry products, can be present in poultry chill waters and processing

equipment, and can be readily isolated from hatcheries, broiler farms, and fresh eggs. The bacteria have several roles within the poultry processing environment, including food spoilage, primary biofilm formers and, in the case of *P. aeruginosa*, as a pathogen. Currently, only traditional agar methods and biochemical based assays are available for detection and differentiation. Biochemical assays take 5 days for results, are expensive, and often produce erroneous results. The objective of this study was to design a rapid PCR based method that could not only distinguish *P. aeruginosa* from other poultry significant Pseudomonads, but also differentiate *Pseudomonas* spp. from non-*Pseudomonas* bacteria in a single PCR reaction. 16s rRNA sequences from 9 poultry significant Pseudomonads were aligned to determine conserved regions from which genus specific primers could be designed. The Gyrase B sub-unit genes from the 9 species of Pseudomonads were used to design species specific primers for the detection of *P. aeruginosa*. The PCR reaction was optimized using the Qiagen Multiplex Kit according to the manufacturer's instructions. The reaction was tested against 16 *P. aeruginosa* strains, 18 *Pseudomonas* non-*aeruginosa* strains, and 17 non-*Pseudomonas* bacterial strains composed of 7 genera and 11 species. The reaction was 100% specific. Furthermore, the assay could be started in as quickly as 20 hours or as soon as bacterial colonies appeared on the agar plate to which the sample had been applied. When compared to methods of traditional plating on differential or selective agar, biochemical assays, and gene sequencing, the PCR based assay was able to eliminate 4 to 6 days from total detection time. In addition, the PCR assay was the least expensive, costing around $0.15 per reaction. Because this PCR based assay reduced detection time to 24 hours and simplified the identification process, it may be used to reduce food spoilage and foodborne illness by identifying sources of contamination and speed the diagnosis of ill birds.

Key Words: Pseudomonas, Detection, PCR, Poultry, Spoilage

P212 Bacteria recovery from genetically featherless broiler carcasses after forced clocal evacuation. J. K. Northcutt*[1], W. D. McNeal[2], K. D. Ingram[1], D. L. Fletcher[3], and R. J. Buhr[1], [1]*USDA-ARS*, *Athens, GA*, [2]*Meyn America. LLC*, *Ball Ground, GA*, [3]*University of Connecticut*, *Storrs*.

A study was conducted to determine external microbiology of genetically featherless broiler carcasses after forced evacuation of clocal material. Full-fed featherless broilers were shackled, stunned, suffocated, weighed and divided into treatments groups (S, W and SW). Carcasses from all treatments were transferred to a separate shackle line and passed through a machine designed to express (squeeze) and remove feces (wash). Treatments were obtained by turning on or off the squeezing and washing components. After treatment, carcasses were subjected to a whole carcass rinse for microbiological analyses. Treatments were as follows: S carcasses were squeezed but not washed; W carcasses were not squeezed but were washed; and SW carcasses were squeezed and washed. When carcasses were washed, they gained weight (8.6 and 2.1 g for W and SW, respectively), while unwashed carcasses (treatment S) lost approximately 6 g of feces. Recovery of *Escherichia coli* (EC), coliforms (CF), and *Campylobacter* (CP) from carcasses did not vary with treatment and levels were approximately 3.4, 3.7 and 2.7 $\log_{10}$ cfu/mL of rinse, respectively. A slightly lower (0.3 log), but significant difference in total aerobic bacteria (APC) was observed for SW carcasses compared to W carcasses. *Salmonella* (SAL) prevalence was similar for all treated carcasses (83 to 90% positive). When the water from the machine's washing component was analyzed, counts for APC, EC, and CF were 3.6, 0.8, and 1.0 $\log_{10}$ cfu/mL lower for W carcasses than for SW carcasses ($P < 0.05$). CP and SAL prevalence in the water collected from the machine after W carcasses were washed was 1/4 and 0/4, respectively. CP and SAL prevalence in the water collected from the machine after SW carcasses were washed was 3/4 and 2/4, respectively. Data from the present study show that fecal material may be expressed and washed off of carcasses immediately after slaughter. This equipment could be used to minimize deposition of organic material onto the carcass and into the scalder and improve bird uniformity at evisceration.

Key Words: Poultry, Carcass bacteria recovery, Broiler carcass evacuation, Carcass washing

P213 Characterization and antimicrobial resistance of *Salmonella* isolated from internal tissues, ceca and rinse samples from commercial broiler chickens. J. S. Bailey*[1], N. A. Cox[2], P. Fedorka-Cray[1], L. J. Richardson[2], and J. Buhr[2], [1]*USDA, ARS, BEAR*, *Athens, GA*, [2]*USDA, ARS, PMS*, *Athens, GA*.

The presence, species, and antimicrobial resistance profile of Salmonella from internal tissues (spleen, liver/gall bladder, thymus, MeckelÃ¢â‚¬â„¢s diverticulum, and free floating yolk), ceca and carcass rinse samples were determined from six-week-old (n=30) and eight-week-old (n=40) commercial broilers from the rehang line before evisceration. *Salmonella Typhimurium* was the predominate (153/175, 87%) serotype of the seven serotypes identified. S. Typhimurium isolates were more frequently associated with internal tissues (102/153, 67%) than with ceca and rinse samples (3/22, 14%). The seven isolates that were pan susceptible were from ceca and rinse samples while 156 of 158 (99%) of isolates resistant to two or more antimicrobials were from internal tissue samples. These data indicate that chickens can harbor the same serotypes with different antimicrobial patterns in tissue samples compared to ceca and rinse samples. Further studies are warranted to determine the relatedness of isolates.

Key Words: *Salmonella*, Antimicrobial resistance, Broilers

P214 A survey of the quality of six retail brands of boneless skinless chicken breast fillets obtained from retail supermarkets in Athens, Georgia area. H. Zhuang*, E. Savage, S. Kays, and D. Himmelsbach, *USDA-ARS*, *Athens, GA*.

To assess the variation in quality of chicken breast fillets available from retail supermarkets, six brands of boneless skinless fillets without additives were obtained from the fresh counter at grocery stores Athens, GA and the surrounding area during fall of 2005. The samples were stored at -20oC before being cooked using a Henny Penny MCS-6 combi oven. Quality parameters of the fillets were measured on the cooked chicken breast fillets including cook yield, descriptive sensory flavor and texture profiling, and Warner-Bratzler (WB) shear force. Our results show that the average cook yield ranged from 78.1% to 80.9%, the average intensity of descriptive sensory characteristics was less than 5.4 in a 0-15 universal scale, and WB shear force values were less than 5.2 kg. There were no significant differences in the intensity among brands of all flavor attributes and the texture characteristics

associated with moisture. However, significant differences were found among the brands for cook yield, mechanical properties of texture (including springiness, cohesiveness, hardness and chewiness) and WB shear force values. The variation of WB shear force measurements (coefficient of variation) depended on brand. These results indicate that differences exist in the quality and texture consistency among brands of boneless skinless chicken breast fillets available in Athens, Georgia and the surrounding area.

Key Words: Chicken, Breast, Boneless, Sensory, Quality

P215 The effect of the addition of a novel source of docosahexaenoic acid (DHA) to layer diets on the DHA content of eggs. A. J. Pescatore*, J. L. Pierce, A. H. Cantor, T. Ao, M. J. Ford, and B. L. Shafer, *Alltech-University of Kentucky Nutrition Research Alliance*, *Lexington, KY*.

A novel source of docosahexaenoic acid (DHA) that is a by product of food grade DHA production was used to enhance the DHA content of eggs. The DHA containing additive was added to corn-soy based layer diets (16% cp, 2815 kcal/kg) at a rate of 1% or 2% of the diet. Dietary treatments were randomly assigned to 27 hens per treatment. The treatment diets were fed for 27 days. Egg samples were collected at day 0 and day 27. The DHA content of the eggs from all hens at the start of the experiment was 1.06 % total fat (w/w). The eggs from hens fed the zero additional DHA diet showed no increase in DHA (1.05%) at 27days. Eggs from hens fed the DHA source for 27 days had a DHA content of 2.85 and 3.40 % (w/w) for the 1 and 2 % inclusion rates, respectively. The levels compare favorably to commercial omega 3 enhanced eggs. The results of this experiment indicate that the inclusion of this DHA source at the rate of 1% will increase DHA level in eggs. Only a slight increase was seen with the 2% inclusion rate compared with 1% inclusion rate and may not warrant the added cost of the higher rate.

Key Words: Layer hen, DHA, Egg

P216 Dietary flaxseed supplementation affects processing yields and meat technological properties. M. Betti*[1], M. J. Zuidhof[2], B. L. Schneider[2], R. A. Renema[1], V. L. Carney[2], F. E. Robinson[1], and D. R. Korver[1], [1]*University of Alberta*, *Edmonton, AB, Canada*, [2]*Alberta Agriculture Food and Rural Development*, *Edmonton, AB, Canada*.

Consumers are becoming more aware of the impact of the food they eat on their health. One of the ways they hope to reduce their risk of cardiovascular disease is by consuming more foods enriched with polyunsaturated fatty acids (PUFA), particularly omega-3 (n-3) fatty acids. Due to the high content of alpha-linolenic, flaxseed is a good source for increasing the omega-3 fatty acid in poultry meat. However, flaxseed has anti-nutritional properties that negatively impact broiler performance. For this reason, a study was conduted to identify an optimum level of enrichment of broiler diets with flaxseed and the optimal length of time they must be provided to ensure a) good processing yield and b) acceptability of broiler meat functional properties such that processing and further processing efficiencies are not compromised. This experiment was conducted as a 2 x 8 factorial, with two dietary levels of ground flaxseed (10 and 17%), and eight durations of inclusion in the diet prior to processing (0 [Control], 4, 8, 12, 16, 20, 24, and 35 d). Six hundred and fifty-six Ross x Ross 308 mixed-sex broilers were evaluated in this study. One hundred twenty-eight carcasses were used for evaluating processing yields and breast and thigh meat quality. No statistical interactions were found between treatments for meat quality traits. With more than 20 d of feeding duration, the diet containing 17% flaxseed decreased BW, and carcass and breast yield compared to the diet containing 10% flaxseed ($p<0.0001$). Carcass temperature was higher ($p<0.001$) in birds fed 10% flaxseed. Feeding 17% flaxseed also decreased cooking yield ($p<0.001$). The duration of feeding flaxseed strongly affected processing yields and technological meat properties. Ultimate pH and cooking yield were strictly related to each of the periods tested ($p<0.0001$; $p<0.001$). In particular, feeding flaxseed for 35 d resulted in a final pH of 5.79, compared to 6.20 in the control. In conclusion, different levels and durations of flaxseed feeding significantly affected yields and technological characteristics of broiler meat.

Key Words: Flaxseed, Polyunsaturated fatty acids, Alpha-linolenic acid, Processing yield, Technological properties

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